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CONDUCTED BY

PRIDEAUX JOHN SELBY, Esq., F.L.S.,
CHARLES C. BABINGTON, Esq., M.A., F.R.S., F.L.S., F.G.S.,
JOHN EDWARD GRAY, Ph.D., F.R.S., F.L.S., V.P.Z.S. &c.,
ARTHUR HENFREY, F.R.S., F.L.S., Prof. Bot. King's Coll. Lond.,

AND

WILLIAM FRANCIS, Ph.D., F.L.S.

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quelque soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

CONTENTS OF VOL. IV.

[THIRD SERIES.]

NUMBER XIX.

NUMBER XX.

NUMBER XXI

PLATES IN VOL. IV.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

"................ per litora spargite muscum
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hic carpite flores;
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo.
N. Parthenii Gia..

No. 19. JULY 1859.

I.—*On the Metamorphoses of the* Vorticellæ. By M. Jules D'Udekem*.

THE history of the development of the Infusoria has remained one of the most obscure questions in natural science.

The older authors, who had but very imperfect means of observation at their disposal, took little note of it, and this only with a view to one object—namely, to prove the existence of spontaneous generation. The inutility of their efforts is well known. Modern naturalists have observed the Infusoria rather under the point of view of zoology than of physiology; and it is really only within the last few years that the history of the development of the Infusoria has acquired a prominent place, and that observers of the first rank have given their whole attention to it: hence we may hope that this important question will ere long make striking progress.

My purpose in this essay is to examine carefully one of the most controverted points in the history of the development of the Infusoria—the metamorphosis of the species of the family of Vorticellina into the corresponding species of *Acinetæ*.

Before giving the results of my own observations, I shall endeavour to trace, as concisely as possible, the history of the subject I intend to treat.

* From the 'Journal de la Société Médicale de Bruxelles.' Translated by Arthur Henfrey, F.R.S., &c.

I shall not enter into any detail relative to the description of the Vorticellina and the *Acinetæ*, as this would lead too far away from my subject: I refer my readers to the great work of Ehrenberg, and to other general treatises on the Infusoria: I shall deal with the history only from the point where the question of the metamorphoses arose.

Dr. Pineau, in an essay published in the 'Annales des Sc. Naturelles' (3 sér. iii. p. 182, and iv. p. 103), made known that he had observed the Infusoria described by Ehrenberg under the name of *Acinetæ*, become transformed into *Vorticellæ*. No deep acquaintance with microscopic studies is requisite to convince any one that the observations of Dr. Pineau are deficient in that exactitude which must be demanded of every conscientious naturalist; so that I should not attach any importance to the results he supposed himself to have obtained, had he not been the first who sought to establish a relationship between the *Acinetæ* and the Vorticellina.

A few years later M. Stein published, in Wiegmann's 'Archiv' (1849), his researches upon the developments of *Vorticella microstoma*, *Vaginicola crystallina*, and *Epistylis nutans*. He sought to prove, by these three examples, that Infusoria belonging to the family of the Vorticellina became transformed into *Acinetæ*. This opinion was adopted pretty generally among the German naturalists, in spite of the important adversaries it met; in the front rank of the latter must be named the celebrated Ehrenberg.

In 1854, M. Stein published a new and very extensive work upon the development of the Infusoria, and he enlarged particularly upon the metamorphoses of the Vorticellinæ.

He endeavoured to show that each species of the family of Vorticellina has a species of *Acineta* corresponding to it; that ciliated embryos originate in the interior of the *Acinetæ*; and that these ciliated embryos, when set free, become transformed into Vorticellina.

M. Stein gives this last part of his opinion only as an hypothesis, which he considers very probable, but which he has not succeeded in proving, having never been able to trace the ulterior development of the ciliated embryo.

This author believed that he proved the transformation of the Vorticellina into *Acinetæ*, first by a direct observation upon *Vaginicola crystallina*, then by the simultaneous presence in the same infusions of numerous species of Vorticellina and corresponding species of *Acinetæ*, and finally by the alternate appearance of Vorticellina and *Acinetæ* in the same infusion.

Last year appeared a very remarkable essay on the Infusoria, by M. Lachmann*, in which he strongly attacks M. Stein's

* Annals of Natural History, ser. 2. xix. pp. 113, 215.

opinions on the development of the Vorticellina, and denies the metamorphosis of the latter into *Acinetæ*; he thinks that these two families should remain separate, and that no bond of relationship exists between them.

He attacks M. Stein's opinion by well-grounded and serious objections, and regards as inexact and inconclusive the observation by which M. Stein thought to demonstrate the metamorphosis of *Vaginicola crystallina* into *Acineta mystacina*.

With regard to the arguments used by M. Stein, derived from the simultaneous appearance of the *Vorticellæ* and the *Acinetæ*, and the alternation of the appearance of these two Infusoria in one and the same infusion, M. Lachmann objects to them as proving nothing.

In the course of the present paper I shall have occasion to recur to these different objections; for the moment, I shall confine myself to mentioning them.

M. Lachmann finally overturns completely the hypothesis put forward by M. Stein upon the transformation of the ciliated embryos of the *Acinetæ* into *Vorticellæ*; he shows, by numerous examples, that these embryos become transformed into *Acinetæ*; and he attributes the first discovery of this important fact to J. Müller.

The essay of M. Lachmann had not yet reached Belgium, last year, at the time when I presented to the Royal Academy of Sciences the results of my researches upon *Epistylis plicatilis*. The following is the *résumé* of my observations which I gave in that memoir:—

"*Epistylis plicatilis*, before or after it has acquired its full growth, becomes enveloped in a cyst, either remaining attached to its style, or abandoning it, or re-uniting in one and the same cyst.

"Entirely enclosed in the cyst, the animal undergoes a total transformation. Its mouth, peristome, and integuments disappear by dissolving into a sarcodic liquid, in which are suspended globules of different sizes; the nucleus of the *Epistylis* alone appears able to resist this solution. Upon the surface of the sarcodic liquid a new resisting contractile integument makes its appearance, covered with vibratile cilia, and closed at all points.

"The *Epistylis* is then metamorphosed into a new Infusorium having much analogy to the *Opalinæ* which are met with in Frogs.

"The *Opalina* (we will provisionally apply this name to the new Infusorium originating by the metamorphosis of the *Epistylis*) revolves, and acquires such dimensions that the cyst, not being elastic, bursts, and gives passage to the animal which it

previously contained. Once free, the latter swims about, and seeks a suitable place on which to fix itself. Having found this, it proceeds to undergo a new metamorphosis, which may produce two different forms. Sometimes the *Opalina*, which is spherical or more or less oval, becomes fixed by one of its extremities, whence arises a style, which grows rapidly; at the other extremity appear four bundles of retractile tentacles.

"In the second case, the *Opalina* does not become fixed by one of its extremities, but seems to become flattened out upon the foreign body; it remains sessile, and a more or less considerable number of bundles of tentacles appear on its circumference. In the two preceding cases, the vibratile cilia covering the integument of the *Opalina* vanish from the moment when it becomes fixed.

"The two forms which I have just described are *Acinetæ*. The first is identical with that represented by M. Stein, pl. 1. fig. I. D. of his work; the second is an *Acineta* not hitherto described. The metamorphoses of *Epistylis plicatilis* stop here. The *Acinetæ* grow, and become more and more developed. In their interior is found a nucleus, which increases in size, and makes its way towards the internal surface of the integuments. By the contractions of the animal, the latter become ruptured, and the nucleus is set free. This nucleus, which is really a bud, of discoidal form, moves with extreme activity by the aid of long vibratile cilia which decorate its surface. The *Acinetæ* give birth, successively, to several ciliated buds, and terminate their existence without undergoing any further metamorphosis.

"The ciliated buds, after their emission from the *Acinetæ*, become metamorphosed into young *Acinetæ*; they affix themselves to a foreign body, either remaining sessile or producing a style; their vibratile cilia disappear, and are replaced by four bundles of tentacles.

"The new nuclei reproduce new ciliated buds in their interior."

From this it will be seen that I thought myself the first discoverer of the transformation of the ciliated embryos into young *Acinetæ*; I hasten to restore the property in this discovery to its rightful owner, the illustrious physiologist, J. Müller.

Now that I have given the history of the question, I shall attempt, from the materials furnished by the observations of my predecessors and by my own, to show that what I have described of *Epistylis plicatilis* will apply to many species of Vorticellina, and perhaps to all.

I shall examine, then, 1. the encystment; 2. the transformation of the Vorticellian in the interior of the sac into an Infusorium with its whole surface ciliated, and without any orifice in

its integuments (*Opalina* or *Bursaria*); 3. the transformation of the *Opalina* into an *Acineta*; 4. the appearance of ciliated embryos in the interior of the *Acinetæ*; and, 5. the transformation of the ciliated embryos into young *Acinetæ*.

1. *The Encystment.*

The encystment, observed first by M. Stein in different species of Vorticellina, and subsequently by several naturalists in many other Infusoria, now appears to exist among all the animals of this class. I shall deal here only with the Vorticellina. I shall first indicate in what species the encystment has been observed; then, how it takes place; I shall discuss, in the third place, the view which is to be taken of this phænomenon, and what is its probable purpose.

I have observed the encystment in four species of *Vorticellæ*. First, in *Vorticella microstoma*: this is the example in which it is most easy to see the phænomenon; for in almost all liquids where it is met with, we find cysts at the same time, which, as we shall see further on, does not always happen with the other species. When an infusion containing *Vorticella microstoma* is concentrated by evaporation in the open air, the cysts become very numerous. The thickness of the cyst differs in different individuals; sometimes it is thin and fragile, sometimes thick and hard; sometimes it is covered with prominent points. M. Stein was the first to describe the phænomenon of encystment in *Vorticella microstoma*.

I observed the encystment in a species of *Vorticella* not hitherto described, and which I shall call *Vorticella microstyla*, on account of the shortness of the style, which never forms a complete turn of a spiral when the animal contracts. I have met with this species only in a single spot in the environs of Brussels. I hope to give a more complete description of it on a future occasion. As the cysts, in this species, very closely resemble those of *Vorticella microstoma*, they do not require a particular description.

I have several times met with cysts of *Vorticella Convallaria*; but they are more difficult to observe, because, this species being more delicate than those of which I have just spoken, the individuals mostly die without becoming encysted.

Lastly, I have observed the phænomena of encystment in a fourth species of *Vorticella*. This species, which I met with upon our coast at Ostend, has not yet been described; it is extremely remarkable on account of a membranous prolongation surrounding the peristome, which gives it, when expanded, the form of a parasol; when it is contracted, this membrane becomes plaited and folded up in the interior of the body.

M. Stein has observed the encystment of *Vorticella nebulifera*. In the genus *Carchesium*, I have observed the cysts of three species—those of *Carchesium polypinum*, of *Carchesium ramosissimum*, and of *Carchesium pygmæum*; there is scarcely any difference between them, and they entirely resemble the cysts of the *Vorticellæ*.

In the genus *Epistylis* I have only been able to observe the encystment in two species—*Epistylis plicatilis*, and an *Epistylis* which I think new, and which I have often met with living parasitically upon the posterior extremity of *Tubifex* and *Nais*. M. Stein also has observed the encystment of *Epistylis plicatilis*. I have sought in vain for the cysts of *Epistylis grandis* and *E. flavicans*, two species very common in our environs; I attribute this to the difficulty of preserving these animals alive in vessels in the study.

In the genus *Opercularia*, my observations have been made on *Opercularia nutans*, *O. Lichtensteinii* (Stein), and *O. microstoma*. I have seen the encystment only in the first of these three species; the two others being far more rare, it is not surprising that this phænomenon should have escaped me.

Finally, M. Stein has observed and described the encystment of *Vaginicola crystallina*; I have made a similar observation.

Summing up all these observations, I shall conclude that species susceptible of encystment are met with in all the genera of the family of Vorticellina, and that it is very probable that this phænomenon presents itself in all, when favourable circumstances tend to induce it.

The Vorticellina may become encysted at all periods of their existence; they are encysted either while remaining attached to the style or after they have abandoned it, subsequently to the appearance of a basilar crown of cilia. Lastly, while the Vorticellina are reproduced by fission, they may still become encysted; and I have observed among them all the intermediate conditions between the commencement of the division and its completion, simultaneously with the appearance of cysts.

The encystment takes place in the same manner in all the Vorticellina in which I have observed it. The individual which is about to present this phænomenon contracts slightly, and closes its peristome; around it appears a cloud, formed by a viscid liquid, which is probably the result of a cutaneous secretion. In this liquid are formed granules, which, augmenting more and more in number and adhering together, finally form a membrane, which becomes hard and resisting, although soft and flexible when first produced. The cyst thus formed does not change its state, or augment in thickness by the deposition of new granules in its interior. When a cyst encloses two indi-

viduals, it is often reniform, sometimes oval; the surface of the cyst becomes in some cases rough with little points.

The cause of the encystment escapes us, like the causes of almost all physiological phænomena. For its explanation we may have recourse to two hypotheses:—either the animal is induced to become encysted by the influence of an internal cause—the phænomenon of encystment being then physiological, normal, and occurring necessarily; or the animal becomes encysted from the influence of external agents—the phænomenon then being abnormal and depending on chance. Of these two hypotheses the second appears the more probable; indeed I have always remarked that most of the Vorticellina become encysted when the liquid containing them evaporates through exposure to the air; moreover, we find a greater number of cysts in winter than in any other season. I conclude from this that drought and cold are two causes of encystment; that these two causes are probably not the only ones, but that there doubtless exist others which it is more difficult to appreciate.

The encystment of the Vorticellina appears to have a double purpose: first, to withdraw these very delicate animals from the destructive action of drought and cold; in the next place, to allow them to undergo certain metamorphoses protected from all external influences.

2. *Transformation of the Vorticellian, in the interior of the cyst, into an Infusorium ciliated over the whole surface, and presenting no orifice in its integuments* (Opalina *or* Bursaria).

The observations of M. Stein, M. Lachmann, and myself agree in showing that the majority of the Vorticellina may remain in the interior of the cysts without undergoing metamorphosis; they are then under the influence of a state analogous to the hybernal sleep of the higher animals. When circumstances are favourable, that is to say, when humidity and a certain degree of heat are restored, they burst their envelope and resume their former life.

In M. Stein's work, he treats of several metamorphoses undergone by the Vorticellina in the interior of the cysts; not having observed these, I shall not speak of them, and shall occupy myself solely with that transformation which I have indicated at the head of this section.

The metamorphosis of a Vorticellian, in the interior of a cyst, into an Infusorium ciliated over the whole surface, was for the first time described by me in my memoir on the development of *Epistylis plicatilis*. The following is the account I gave of the phænomenon.

The *Epistylis plicatilis*, in the interior of the cyst, becomes

attenuated, and seems to fold upon itself; the sarcodic substance traverses its integuments in all parts; from time to time it still contracts; and a complete solution soon affects the whole animal, so that we find in its place merely a homogeneous sarcodic liquid, containing granules, together with the nucleus, which resists the general destruction. In the sarcode there takes place a process which may be in some measure compared with what occurs in the vitellus after the fecundation of an ovum. The granules, becoming united together, form groups which soon divide and subdivide; at the same time an integument is formed upon the surface, in the same manner as the blastoderm appears in the eggs of the inferior animals. This integument is contractile, covered with vibratile cilia, and closed at all points.

The transformation is then complete; the cyst contains a new Infusorium, which may be compared to the *Opalinæ* or *Bursariæ*, which are met with in the intestines of the Batrachians.

This description of *Epistylis plicatilis* may be applied in all its details to the Vorticellina in which I have observed the transformation into an Infusorium ciliated over the whole surface. It will be useless to revert to it. I shall simply indicate the species in which I have observed it. This metamorphosis may be found almost at will in *Epistylis plicatilis*; but it is not so with other species of the same genus. I have sought for it in vain in *Epistylis grandis* and *E. flavicans*; and I have only met with it in the *Epistylis* of *Tubifex*, the new species of which I have already spoken.

In the genus *Vorticella*, I have observed this metamorphosis in *Vorticella microstoma, microstyla, Convallaria*, and in the *Vorticella* with a fringed peristome described above.

Carchesium polypinum and *arbuscula* likewise undergo similar metamorphoses in the interior of the cysts.

3. *Transformation of the Infusorium ciliated all over* (Opalina *or* Bursaria) *into an* Acineta.

I have said, in the historical part of my essay, that M. Stein was the first who sought to demonstrate the metamorphosis of the Vorticellinæ into *Acinetæ*; from what I have just said, in the preceding paragraph, it may be seen that my opinion differs entirely from his upon the point—that I do not suppose, with him, the immediate transformation of the Vorticellina into *Acinetæ*, but that an intermediate metamorphosis exists.

Hence none of the arguments produced by M. Lachmann against M. Stein's opinion can touch mine; I shall, however, endeavour to reply to some of them, because they tend to deny

the existence of a metamorphosis. But, before commencing this discussion, I will give the description of this new transformation.

I have indicated in the preceding paragraph that certain Vorticellina become transformed, in the interior of a cyst, into a spherical Infusorium having an integument closed at all points, and entirely covered with vibratile cilia. This new Infusorium performs, within its envelope, a continual rotation. In another paper, I have compared this rotation to that performed by the embryos of Gasteropod Mollusca within the egg.

While the metamorphosed Vorticellian revolves, it undergoes development, increases in size, and its whole surface becomes covered with folds; finally, a moment arrives when the cyst, yielding to the pressure exerted in its interior, bursts; the ciliated Infusorium becomes free, and swims with a rotating movement.

To discover how this Infusorium becomes transformed into an *Acineta* requires attentive observation, in order to avoid all the chances of error which may present themselves, and which are numerous.

I believe myself authorized in supposing the existence of this metamorphosis, because I have observed Infusoria which presented, on the one hand, all the characters of *Acinetæ*, and, on the other, the characters of the Infusorium produced by the transformation of the Vorticellina.

Three times I have observed individuals of *Acineta mystacina* already provided with tentacles, and which had the spherical form and the body covered with vibratile cilia. I have doubtless seized in those cases the moment of the metamorphosis of the ciliated Infusorium (*Opalina*) into an *Acineta*. It may be objected that the cilia with which these *Acinetæ* were covered belonged to the embryonary state; the answer to this objection is easy: the cilia of the embryos are arranged in a totally different manner, and occur only upon *Acinetæ* of very small size; they fall off very early, before the appearance of the tentacles.

I shall now discuss the objections of M. Lachmann against the theory of M. Stein, so far as they might be applied to my opinion. M. Lachmann thinks that the forms indicated by M. Stein as degrees of transition between the Vorticellina and the *Acinetæ*, are really only different species of Infusoria, which have no other relation beyond a more or less considerable resemblance. This objection is indeed applicable to the observations of M. Stein. That author has not taken sufficient pains to show the interconnexion of the different transitory forms. For my own part, I think I am entirely out of reach of this objection, and what is said above sufficiently proves it; thus I have demonstrated how certain Vorticellina become transformed into ciliated Infusoria

(*Opalina*), and how these *Opalinæ* become covered with tentacles and metamorphosed into *Acinetæ*.

The second objection of M. Lachmann against M. Stein rests on the opinion that the simultaneous appearance of *Acinetæ* and Vorticellina in the same infusion cannot be regarded as a sign of relationship between these two species. I quite agree with M. Lachmann upon this point; however, I believe that the simultaneous appearance of two Infusoria always and everywhere in the same infusion affords great probability of the real existence of the metamorphosis of one species into the other. Numerous observations have led me to the certainty that one may almost affirm, *à priori*, that where a species of Vorticellina is observed, we shall find a species of *Acineta*, and *vice versâ*.

Not only have I found most of the *Acinetæ* described by M. Stein as accompanying certain Vorticellina, but, further, when I have met with a new Vorticellian, I have at the same time found a new species of *Acineta*.

A third objection of M. Lachmann must be taken into serious consideration. According to him, the alternation of the appearance of the Vorticellina and the *Acinetæ* in the same infusion does not in any way indicate that one species arises out of the transformation of the other. Indeed this alternation occurs with a very great number of Infusoria; and, as M. Lachmann has rightly said, this is what led MM. Pineau, Gros, and Laurent to suppose that most of the species of Infusoria are only stages of development of one and the same species. M. Lachmann adds—"An alternation of the appearance of certain Infusoria may really give a demonstration of the relationships which exist between them, if one makes certain, by complete isolation in a very circumscribed space, that only individuals of one species exist there."

M. Stein has, it is true, neglected this experiment; for my own part, I have repeated it several times, and, after numerous efforts, I have discovered *Acinetæ* in the liquid in which I had isolated specimens of *Epistylis plicatilis*. I must confess, however, that I do not attach the same importance to these experiments that M. Lachmann attributes to them; the causes of error are too numerous,—above all, on account of the great difficulty of completely isolating a species of Infusorium.

The other objections of M. Lachmann are addressed to the second portion of M. Stein's theory, that is to say, to the transformation of the embryos of *Acinetæ* into Vorticellina. It is unnecessary for me to discuss this here; that question is now cleared up, as I have already said, in the historical summary which stands at the head of this paper.

M. Lachmann terminates his objections by saying that the

metamorphosis of Vorticellina into *Acinetæ* is improbable, because it cannot be compared with anything taking place in other animals. I shall answer this in the words of a great physiologist: "One must be very bold to assign limits to nature."

4. *Appearance of Ciliated Embryos in the interior of the* Acinetæ.

The discovery of the origin of ciliated embryos in the interior of the *Acinetæ* is due to M. Stein. M. Lachmann announces that he has made a similar discovery in a great number of *Acinetæ*. I also found this embryo in the *Acineta* of *Epistylis plicatilis*, and subsequently in all the *Acinetæ* I have met with, among which are many species not yet described. All naturalists are now agreed as to the appearance of the ciliated embryos in the *Acinetæ*, and their formation at the expense of the nucleus; but one point is still controverted, namely the manner in which the nucleus behaves during the production of the embryo. According to M. Stein, the division of the nucleus appears to precede the formation of the embryo; but M. Cohn regards this division as improbable. It appears that M. Lachmann has studied this question with much care; but as he only gives the result of his observations on the Infusoria in general, and not especially for the *Acinetæ*, it is impossible to know his opinion upon this point. With regard to myself, notwithstanding all the pains I have taken, I have never been able to see the division of the nucleus of the *Acinetæ* before the production of the embryo, as indicated by M. Stein; on the contrary, I have always seen the nucleus totally converted into an embryo, and after the expulsion of the latter, a new nucleus has been formed, which, in its turn, became transformed into a new embryo, and so on.

5. *Transformation of the Ciliated Embryos into young* Acinetæ.

M. Stein, after discovering the production of ciliated embryos in the interior of the *Acinetæ*, stated, as a very probable hypothesis, that these embryos, once free, become transformed into Vorticellina; however, he never succeeded in tracing the ulterior development of these embryos; the latter always escaped him. More fortunate than M. Stein, M. J. Müller succeeded in tracing these embryos, and saw them become fixed, and transformed into young *Acinetæ*. M. Lachmann arrived at the same result.

These observations of MM. Müller and Lachmann were not yet known, as I have already said, in Belgium when I presented to the Academy my work on the development of *Epistylis plicatilis*; in that work I described this curious transformation of the ciliated embryo into a young *Acineta*, thinking myself the first to observe it. Since then, I have succeeded in detecting

this metamorphosis in almost all the embryos. Does this transformation of the ciliated embryo into a young *Acineta* always take place? It is allowable to doubt this; twice I have seen ciliated embryos become enclosed in a cyst, instead of changing into young *Acinetæ*. I was unable to carry the observation further, and ascertain whether or not the Infusorium underwent new transformations in the interior of the cyst. Further researches are required to clear up this obscure question.

II.—*On the Development of the Vegetable Ovule called 'Anatropous.'* By John Miers, F.R.S., F.L.S., &c.

Although the changes that take place in the development of the vegetable ovule have long since occupied the attention of the ablest physiological botanists, it is evident that the real nature of its mode of growth is not yet well understood. My first object therefore is to show that the doctrine upon this important subject, as taught in the best elementary works, is founded upon a very grave error. I was led into this inquiry by my desire to ascertain the nature of the fleshy covering enveloping the hard tunic in certain seeds *, and which appeared to me arilloid in its nature. This was contested by Dr. Asa Gray, who considered these two very opposite kinds of tunics as one baccate testa, both deriving a common origin from the primine of the ovule †. To this view I was unwilling to subscribe; and in my subsequent discussion of the subject, trusting fully to the orthodoxy of the common creed of botanists on the development of the ovule, I argued ‡ that the fleshy covering in question must be an expansion or growth of the placentary sheath, because it enclosed the raphe: and so it is undoubtedly—but not in the light of an extraneous expansion, as I then viewed the question. This induced me to examine, by personal observation, the actual progress of growth of the ovule in certain plants which produce what have been called anatropal seeds; and I soon became convinced that I had been led into an error of inference, solely by my faith in the universally prevalent creed. Having lately completed the investigation of many *Rhamnaceous* and *Anacardiaceous* seeds, in which several novel points of structure have been observed, which are difficult to explain, I am desirous, before the publication of these results, that the real nature of the development of the ovule should be well understood. I therefore now proceed to show that the doctrine upon this subject, as at present taught, is completely fallacious.

* Trans. Linn. Soc. xxii. 81. † Journ. Linn. Soc. ii. 106.
‡ Ann. Nat. Hist. 3rd ser. i. 276.

It is important to observe, that the late Mr. R. Brown, to whom science is so greatly indebted for his grand discoveries on this subject, and who in simple language first explained the nature of the changes that take place in the development of the ovule*, does not describe the mode of action objectionably assumed in the writings of physiological botanists; and it is worthy of remark that he never adopted the nomenclature founded upon the doctrine here alluded to†.

To Brongniart, who pursued these great discoveries, the highest merit is due for his able and patient investigation‡ into the nature of the pollen, the peculiar structure of the stigmatic tissues, the mode in which the pollinic influence is conveyed into the ovary, the structure of the ovule, of its proper tunics, and of the nucleus, the development of the embryo-sac, the production of the embryo, and the means by which the seed is finally perfected. It is also deserving of notice, that in all these careful investigations, no allusion is anywhere made to the inversion of the nucleus, or to any excentric growth of the original tunics that might effect the kind of inversion since assumed to take place in an anatropal ovule. It is true that both he and Mr. Brown commenced their researches upon the ovule from the moment it is ready to receive the pollinic influence; but had either of these careful observers witnessed any such previous action of growth, they would not have failed to allude to the subject.

Mirbel, who confirmed and extended these interesting researches in his celebrated memoir on the development of the ovule §, has received the highest eulogiums from all quarters, for the benefit which these discoveries rendered to science; but it appears to me that the greatest share of this merit is due to Brown and Brongniart, who preceded him in these inquiries. Much praise is certainly due to Mirbel for the lucid manner in which he repeated and confirmed the facts already brought to light by those who preceded him, and also for tracing the growth of the nucleus and ovular coats from their first appearance,

* Appendix to King's Voyage, p. 43.

† The way in which Mr. Brown uses the term *inverted* is in a comparative sense: *loc. cit.* p. 52, where he says, "the inner membrane is inverted with respect to the external umbilicus," or, in other words, that the chalaza is opposed to the hilum; but he does not allude to any *action of inversion* of the ovular tunics.

‡ "Mémoire sur la Génération et le Développement de l'Embryon dans les Végétaux Phanérogames." Ann. Sc. Nat. xii. pp. 14, 145, 225, tab. 34—44: read before the Academy, Dec. 28, 1826.

§ "Nouvelles Recherches sur la Structure et les Développemens de l'Ovule végétale." Mém. de l'Acad. ix. p. 609: lu à l'Académie 28 Dec. 1828. Additions dans un 2nd mémoire lu 28 Dec. 1829; *idem*, p. 629. planches 1–10.

which his predecessors had not noticed; but his greatest claim to distinction rests upon the nomenclature which he devised in order to express the changes observed, which will make his name prominent in the annals of embryology. It is, however, deeply to be regretted that the more original matter contributed in that memoir, or rather, his explanations of the facts there related, should have laid the foundation of the great error in the history of these developments, the fallacy of which I now proceed to demonstrate.

In order that I may be free from the blame of misrepresenting this subject, I will here quote from the following authorities the doctrines they have severally published.

Mirbel says (*loc. cit.* p. 612) that the *anatropal* ovules "*se renversent tout entiers,* et durant *ce mouvement de conversion* le raphé se développe avec la primine, et *transporte le hile de la base de l'ovule à son extrémité supérieure*; ce sont les Anatropes; mais le développement du raphé fait que le *hile* s'éloigne de la chalaze, et *va prendre place* à côté de l'éxostome" (micropyle). He says again (p. 631), "Le funicule, dans un grand nombre des espèces, *se soude longitudinalement* à la primine depuis l'endroit où il forme la chalaze, jusqu'à une distance plus ou moins éloignée d'elle. *Alors* il se montre à la superficie de la primine comme une ligne en relief, qui se termine à la base de l'ovule; cette ligne est le raphé; mais quand il n'y a peu d'adhérence entre la primine et le funicule que là même où les vaisseaux funiculaires pénétrent dans la secondine, la chalaze se confonde avec le hile, qui est le point d'attache du funicule sur la primine, et la place manque pour un raphé." Again (p. 649), "Quand un ovule tend à l'anatropie, la chalaze, c'est-à-dire l'extrémité du funicule, se porte en avant, non dans la direction de l'axe, mais dans une direction un peu oblique, et en suivant une ligne courbe, qui par sa partie supérieure se rapproche insensiblement de l'axe, et tandis que ce mouvement s'opère, *le sommet par un mouvement inverse se dirige vers la place que la base a abandonnée. Il y a donc échange de position entre les deux extrémités de l'axe de l'ovule; cette axe, poussé obliquement par la chalaze, semble se mouvoir comme une aiguille de boussole que l'on ferait tourner sur son pivot.* Mais la chalaze n'étant que le bout du funicule, l'évolution ne saurait s'opérer sans un allongement de ce cordon, égal au moins à la longueur de l'axe de l'ovule."

If we examine the series of progressive analytical drawings by which these changes are demonstrated in that celebrated memoir, we find that the figures are diametrically in contradiction to the explanations. The former, which portray the facts as he saw them, offer the more reliable testimony of the real truth: for example, in plate 3, showing the progressive growth of the

anatropal ovule of *Aristolochia*, fig. 1 is a simple pullulation from the placenta, the rudiment of the primine, or what I have called the placentary sheath, because it encloses in its tissues the nourishing vessels that terminate in a certain budding point, and that form the future raphe; it is not the nucleus, as is generally taught. Close to the extremity of this, out of a circular depression, the first appearance of the nucleus is exhibited in fig. 2. The secundine next presents itself in the same hollow, surrounding the base of the nucleus in fig. 3. After this we observe the gradual swelling of the under part of the nuclear support, or the downward growth of the placentary sheath, which becomes the primine, in the form of a bag suspended by the remaining stipitate portion of the sheath or funicle,—the original margin of the depression first described remaining as the mouth of this bag, and constituting the foramen of the primine (micropyle or exostome), which from first to last never changes its position or its aspect—a most important point to be observed. During this action of centrifugal growth, the chalaza, or place of attachment of the nucleus, necessarily recedes from its original position, remaining at the bottom of the growing bag or primine, the extension of the nourishing vessels keeping pace with its *downward* growth, and still terminating in the now basal chalaza; at the same time, the enclosed nucleus and secundine severally grow *upwards*, both constantly attached to the budding or chalazal point of their origin: all this is seen in fig. 5, which represents a perfect ovule ready to receive the pollinic influence. We find in fig. 6 exactly the same disposition of the parts after the ovule has been impregnated, and when the embryo-sac with the nascent embryo has been developed. In these several stages we perceive that the foramen of the primine, the mouth of the secundine, and the apex of the nucleus, from first to last, all culminate towards one common point, while the basal portions of the same parts as constantly point downwards: if the expression may be allowed, they all retain the same uniform polarity; there is *no inversion* in any of the parts, or even an approach to it; *the hilar or funicular point* of attachment *is not transported from the base of the ovule to its superior extremity*, as asserted; and there is *no agglutination* (*soudure*) *of the primine to the cord of the raphe*, elongated by this assumed act of semirevolution of the ovule. In fine, although the mode of growth, as shown in the drawings, is perfectly correct, there is throughout the whole description a misconception, and a complete mistake in the use of all the terms employed by Mirbel, especially in those I have denoted by italics. The same mode of growth is again still more fully demonstrated in plate 7, in the instance of *Tulipa*. Nowhere among the other numerous exemplifications in

this celebrated memoir can we find any material variation in the direction of the parts of an anatropal ovule: this only exists in campylotropal or amphitropal ovules, where, of course, owing to the curvature of the several parts, from an excessive one-sided growth, a more or less partial inversion takes place.

The same erroneous description is given by the able St.-Hilaire in his 'Morphologie Végétale' (p. 540), where he thus defines the development of an anatropal ovule. Its first appearance upon the placenta is a small protuberance (wrongly said to be the *nucleus* of the future ovule), which by degrees becomes covered by two cups that rise successively from its base and form the future tunics, primine and secundine. The so-called "ovules anatropes, par la *courbure* graduelle de la *base de leur axe*, se rapprochent peu à peu du cordon ombilical, et après avoir *décrit un demi-cercle, le rencontrent, se soudent* avec lui, et le confondent en quelque sorte dans leur substance; souvent le cordon, *ainsi soudé*, se montre comme une proéminence extérieure, mais souvent aussi il ne se laisse point apercevoir; *la partie soudée* du cordon porte le nom raphé." In order to impress this action more forcibly upon the conviction of his readers, St.-Hilaire compares the ovule so developed, to a monopetalous flower in bud, which is made to perform half a revolution, by being inverted and suddenly bent down close to its base, with its peduncle agglutinated to the calyx and corolla; here the calyx and corolla assume the position of the tunics of the ovule—its ovary, the nucleus—and their common base of union, the chalaza,—the pedicel representing the raphe.

A very similar explanation of the anatropy of the ovule is given in the excellent work of Adr. de Jussieu (Cours Élémenmentaire, p. 343), where his definition is aided by figures. Fig. 1 is again erroneously said to be the *nucleus, first developed*; fig. 2 the same, with the primine next appearing; fig. 3 the same, more advanced, with the addition of the second coat (secundine). "Le développement ne marche pas ainsi égal de tous les côtés; *sur l'un il est très-prononcé*, tandis qu'il reste à peu près *stationnaire sur le côté opposé*. Par là, *la pointe* de l'ovule, avec son micropyle *tourné primitivement en haut, se tourne de côté*, puis un peu plus tard en dehors, *puis enfin tout à fait en bas* (fig. 4) *après avoir fait ainsi un demi-tour de révolution. La chalaze* emportée de même avec les tégumens qui s'étendent, et conservant ses rapports avec le micropyle, *fait une révolution analogue*, mais en sens inverse, *et marche de bas en haut*, de manière qu'elle s'éloigne de plus en plus du hile, dont le micropyle au contraire s'est rapproché de plus en plus." Fig. 5 shows a section of the same ovule, where it is explained how "le faisceau vasculaire qui aboutissait à la chalaze, la suit dans sa révolution en s'allongeant,

et ce prolongement forme le raphé." I was led into error of argument, as I have mentioned, solely by my faith in the truth of this last consideration, a doubt of the correctness of which never crossed my mind, taught as it was by such eminent authorities.

The definition of Prof. Lindley (Introd. p. 180) is less explicit, and therefore less objectionable; but he evidently entertained a similar view, though expressed in different terms. He states that in this kind of ovule "*one of its sides grows rapidly, while the opposite side does not grow at all*, so that the *point* (foramen) of the ovule *is gradually pushed round to the base*, while, correspondingly, *the base of the nucleus is removed from the hilum to the opposite extremity*; and when this process is completed, *the whole of the inside of the ovule is reversed.*" It is needless to repeat that this definition is founded upon misconception, or on too much faith in the erroneous descriptions of Mirbel and St.-Hilaire.

Dr. Fritsche (in 1835) was the first who impugned in part the accuracy of Mirbel's observations on the development of the ovule in *Cucurbita*. Mirbel had described the first indication of the growing ovule as a simple cylindrical shoot protruding from the placenta, which after a while exhibits a point, somewhat excentrically placed near its apex, out of which the nucleus forces an opening; this nucleus continues to grow, becoming surrounded at its base by an annular ring, the rudiment of the secundine, while the lacerated opening out of which the nucleus springs forms the mouth of the primine and gives rise to the outer coat of the ovule. Fritsche confirms the accuracy of the appearances thus described, but contends* that the nucleus does not originate in a sort of coleorhizal protrusion as narrated by Mirbel, but that the whole placental shoot in question is in reality the nucleus upon its funicular support, before any indication of the primine and secundine: this shoot is covered by a single epidermal layer of cellular structure; and at some little distance from its extremity a double circular constriction is formed, thus leaving a prominent annular ring round the papilla, which remains as the nucleus, while the portion of the epidermis between the two strictures separates from the internal parenchyma and becomes plicated, so that its folded surfaces unite together in the form of a short tube, thus giving origin to the future secundine. Subsequently that portion of the epidermis below the strictures also separates and becomes folded in like manner, thus giving rise to the future primine. This assumption of the separation of the epidermis I believe to be quite erroneous, for reasons presently to be given; and it will

* Wiegmann's Archiv, i. 2 Band, p. 229.

be seen that, in regard to this early stage of the development, Mirbel was nearer the truth than his opponent.

Schleiden, although he seems to have adopted the erroneous views of Fritsche concerning the earliest origin of the nucleus and ovular tunics, gave (in 1843) an account of their subsequent development and growth, somewhat different from that of Mirbel: he says*, "The funiculus is much elongated, the nuclear papilla bends downwards; and thus the side, either of the naked nucleus or of the simple or of the external bud-integument (secundine or primine), turned towards the funiculus, becomes blended with it. In the perfect seed-bud the nuclear papilla then lies close to the point of attachment, the chalaza opposite to it, and the line from the centre of the chalaza through the middle of the nucleus is straight: such a bud is termed reversed (*gemmula anatropa*); the adherent part of the funiculus is termed the raphe." Schleiden farther aptly remarks—"Excepting Fritsche, not a single botanist has done anything on this weighty point of our subject, not even so much as to re-examine the researches of the distinguished Mirbel and Brown; and we find in consequence, even up to the most recent dates, the false views of Mirbel (and these often sadly disfigured) copied without reflection."

Prof. Henfrey (in 1847), in his truly excellent 'Outlines of Structural and Physiological Botany' (p. 199), thus defines the nature of the anatropal ovule:—"The nucleus is sometimes so affected by the development, that the apex or micropyle comes to be placed next the hilum, and the organic base of the ovule (the chalaza) at the opposite extremity; the vascular cord communicating with the chalaza is extended during the growth of the ovule, and the chalaza thus always communicates with the funiculus by these vessels, which run in the thickness of the coats, in the exterior where there are two. This cord is called the raphe, looking like a prolongation of the funicle adherent to the side of the ovule, and disappearing at the point, which is the organic base." This description, as far as it goes, is the clearest and most truthful detail of the development of the ovule yet given, as it does not allude to any presumed action of the inversion of the nucleus and its ovular coats, upon which all other accounts are more or less based. This scientific botanist, however, appears subsequently (in 1858) to have adopted the prevalent error in contending that "the inversion of the (anatropal) ovule takes place by a one-sided development of the tunics†."

Prof. Asa Gray has lately pursued this inquiry (in 1857) in

* Principles of Scientific Botany, Engl. edit. p. 390.
† Ann. Nat. Hist. 3 ser. i. 356.

a very philosophical spirit, in his investigation into the growth of the ovule of *Magnolia** from its earliest periods; he confines himself solely to the appearances seen in the different stages of its growth, which he illustrates by figures, without reference to any theory on the subject: those figures well accord with the explanation I have rendered of Mirbel's illustrations of the development of the ovule in *Aristolochia* and *Tulipa*; but there appears to me some little error in fig. 2, where the earliest pullulation is always somewhat excentric in instances of anatropy—never at the extreme tip, which would generate an atropal ovule.

Figs. 1-7.

I need not here recite the details of my own observations made in the spring of last year, upon the mode of growth of the anatropal ovule of *Amygdalus*†; suffice it to say that I have repeated them this year with the utmost care, from the very earliest periods of growth, and all that I had previously remarked is fully confirmed. I have noticed here, in every instance examined, as shown in the marginal figures, a deep depression completely upon one side (never at the extremity) of the wart-like pullulation from the placenta, which I have called the placentary sheath, because it encloses in its parenchyma the tracheal vessels of the future raphe, in the bottom of which hollow there is a small budding-point where the vessels terminate; and out of this point the nucleus originates, standing in the bottom of the hollow: this nucleus soon becomes surrounded by the annular rudiment of the secundine, while the margin of the depression by degrees expands into a cup of a horse-shoe form, the two arms of which abut upon and embrace a lamellar plate of the placenta, and the opposite extremity is rounded into a concentric form, surrounding and including the nucleus and secundine. In *Prunus* the wart-like protuberance is more globular than in *Amygdalus*; and upon one side, not far from the placenta to which it is attached, there is a very deep circular depression, in the bottom of which the diminutive nucleus is seen rising from the budding-point: this is gradually encircled by the secundine; and the deeply hollow support becomes first a cup, which finally grows down-

* "A short exposition of the structure of the ovule and seed of *Magnolia*," Journ. Linn. Soc. ii. 106.

† Ann. Nat. Hist. 3 ser. i. 359.

ward to form the primine, while its margin remains as the micropyle. Neither Mirbel's view nor Fritsche's notion is confirmed by my observations; the many cases I have seen convince me that the early growth of the nucleus and secundine proceeds wholly from the budding-point or future chalaza, which is the point of termination of the tracheal vessels imbedded in the substance of the main support or placentary sheath. This mode of growth is most conformable to the ordinary law of development, and is quite analogous to the production of the sepals, petals, stamens, disk, and ovary from the budding-point of the pedicel, which is furnished in like manner, and for the same purpose, with tracheal vessels. It is a far more reasonable inference than the gratuitous assumption of Fritsche, that the ovular tunics are generated by the spontaneous separation of the epidermis, which doubles itself up, so as to produce those tunics by its further expansion.

After this early period, the further increment is very evident: the bottom of the channel I have described, with the budding-point, grows *downward*, becoming by degrees an oblong pouch with a broad, open mouth, suspended by the funicular point of its origin, at the same time that the nucleus and secundine enclosed in it grow *upward*; this continues till we have a complete and suspended anatropal ovule, ready for impregnation, at which period the papillary apex of the nucleus is exposed within the open mouths of the tunics; during this successive growth of the ovule of *Amygdalus*, the apex of the nucleus never changes its zenithal aspect, while the chalaza as constantly points to the base of the cell; there is no one-sided growth of the tunics, which grow equally upon all sides; and there is no inversion of the nucleus or of its coats, according to the opinion generally entertained. In this development, all is beautifully contrived to attain by the most simple means the main function —the generation and perfection of the future embryo, for which purpose the apex of the nucleus is retained always in near proximity to the placenta by means of its short funicle; and close to this point we see, as Brongniart long since demonstrated, a lamellar plate, to which the funicle is attached, which plate, formed of a peculiar tissue, is terminated by a fringed border that overhangs the mouths of the ovular tunics: the articulated cells forming this process bear the name of *telæ conductrices*, because they serve to conduct the pollinic influence to the point of the nucleus, by which means the embryo-sac is impregnated. I mention here this point of structure, because the position of this fascicle of cells, in relation to the raphe, is sometimes an indication of importance, as I shall have to show in the case of the *Rhamnaceæ*.

The mode of origin and the changes that take place in the growth of campylotropal and amphitropal ovules, with some modifications, are quite analogous to all that occur in the anatropal; it is, therefore, unnecessary for our present purpose to speak of them; but in regard to atropal ovules, it is requisite to say a few words. Here the budding-point is at the very apex, not on one side of the placentary sheath; the nucleus therefore makes its first appearance in a depression at that point, where also the secundine soon surrounds it, while the extremity of the sheath is extended by degrees to form the primine,—all three growing straightforward in the same centrifugal direction; the chalazal point is consequently identical with the hilar or funicular point of attachment of the ovule, and therefore there exists in no case any simple raphe, and but rarely any tracheal vessels, except those which exist in the funiculus: the growth of the ovular tunics is just the same as in the anatropal ovules. Spiral vessels, however, are occasionally seen, extending radially beyond the region of the chalaza, through the tissues of the primine, as sometimes occurs in like manner in anatropal ovules.

In the foregoing details of an anatropal ovule, I have mentioned the raphe only as appearing in the shape of a simple cord imbedded in the tissues of the primine, traversing it upon its ventral side from the funicle to the chalaza, where it disappears. But other distinct kinds of raphe occur: it frequently happens that, besides the main cord just mentioned, other branches of the nourishing vessels, as they issue from the funicle, spread themselves in distinct nervures over the whole area of the testa: sometimes, as I have shown in the *Styraceæ*, these ramifications are extremely numerous, the delicate spiral threads being loose or in lax bundles, spread throughout the testa, like a fine web; this also occurs in the testa of *Ophiocaryon*, *Olea*, and many other seeds. In other cases, again, we find these ramifications radiating in distinct nervures from the chalaza and anastomosing over the surface of the seed; this is instanced in the Almond, to which Prof. Lindley has alluded as presenting an anomaly not readily accounted for; its nature is, however, easily explained. The Almond is generally described as being exalbuminous; for if we cut through the seed, we come immediately upon the large fleshy embryo, which is found enveloped by an apparently single flexible coating, but which on examination is seen to be composed of different integuments agglutinated together. The inner coating is easily detached by a blunt point introduced beneath it, by which means it may be separated entire; it is then very thin, almost membranaceous, opake, white, not reticulated, but apparently formed of minute aggregated cells, and perfectly homogeneous in all its parts; it is somewhat thickened over the

radicle, and comes away from the chalaza without discoloration, as easily as from all other parts of the surface; in fact, notwithstanding its attenuation, it presents all the characters of albumen. Intermediate between this and the external integument is a delicate membrane, which is separable with some difficulty, this being the tegmen, finely reticulated: the external testa is much thicker, opake, with a rugose surface. Upon raising the tegmen, we find, lying beneath it, several bundles of spiral threads in anastomosing bands, so loose that each fibre can be easily drawn out separately; these bundles of vessels constitute the branching raphe just described, the ramifications of which appear to issue from the chalaza, where the integuments are united in a solid disk. The source whence these vessels derive their origin in the chalaza may, however, be traced to the main cord of the raphe, which forms a thick bundle running from the hilum to the basal disk. The two integuments are so closely agglutinated together, that it is not easy to determine through which of them the branching portions penetrate; the main cord is manifestly in the outer tunic.

On two former occasions, I recorded two very unusual cases in which the raphe becomes entirely peripherical, that is to say, first runs in the usual manner up one side from the hilum to the chalaza, and then returns again along the opposite side of the seed to the hilum—in both directions in the form of a simple continuous cord: the one instance was in *Stemonurus* *, a genus of the *Icacinaceæ*; the other appeared in *Cucurbitaceæ* †. I have yet to show that a similar abnormal course of the raphe is universal, as far as I have been able to ascertain, in *Rhamnaceæ*. The consideration of this peculiar development will be deferred till I have detailed all the curious circumstances connected with it, in a memoir just completed.

In the *Euphorbiaceæ*, the raphe, as a thick simple cord, runs in a straight line from the hilum to the opposite chalazal extremity, where it is imbedded in the outer tunic, which is sometimes as thick and fleshy as in *Magnolia*, and where, as in that genus, a distinct bony shell intervenes between that coating and the thin inner integument: this raphe perforates the shell through a small diapylar foramen, to reach a small chalaza at the base of that integument; and out of this chalaza I have sometimes observed other vessels distributed over the area of the tegmen, in ten or fewer radiating and almost parallel bands which extend from the base to the apex. The existence of an external arilline, in which the main cord of the raphe is im-

* Ann. Nat. Hist. 2 ser. x. 33; Contributions to Botany, i. p. 83, pl. 13; Trans. Linn. Soc. xxii. p. 98, pl. 19. figs. 6, 7, 8, 9.

† Trans. Linn. Soc. xxii. p. 92, pl. 19. figs. 47, 48, 49.

bedded, and which is often of a scarlet colour, is common to all the *Euphorbiaceæ*; and this is always more or less fleshy, and invariably invests the bony shell usually denominated the testa, but which shell, in all cases, I have found devoid of tracheal vessels.

The development of the ovule in its early stages is subject to many modifications, which, in different families of plants, are often constant; and these afford good characters, hitherto little noticed. Some interesting facts on this head were recorded by Mr. B. Clarke, eight years ago*, when he pointed out the importance of knowing the position of the raphe in its earliest development,—a character he employed to show the relation of different families in a systematic point of view, according to his own peculiar notions.

Prof. Agardh has very lately contributed a valuable collection of facts upon the same head, and with the same view, to which he has attached more importance than they deserve; still, the facts demonstrated by him claim our especial notice, as they are accompanied by nearly 500 figures illustrative of the modes of development of the ovule in 310 different genera of plants. He has shown how much the position of the raphe, in regard to the axis of the ovary, varies in different families, and even in different genera, of the same order; and in his novel systematic arrangement of Phanerogamia†, this difference has in many cases led him to break up many natural orders into distinct groups, which he separates by long intervals, while at the same time he places in juxtaposition other families of little real kindredship, thus suggesting a distribution quite incompatible with our generally received notions of real affinity. But although this new system is not likely to receive the support of botanists in general, still the many observations, and the numerous facts and drawings here contributed, will show the value of the character of the development of the ovule, if applied only as an accessory feature. In order, however, to elicit the true value of this character, it should be followed through all the changes of subsequent growth, up to the period of the perfection of the seed,—a consideration not attended to in that work. I have shown the importance of this last consideration in the *Styraceæ*, especially in the tribe *Halesieæ*; and I have yet to detail developments of a similar nature in other families which I have investigated. It

* "On the Position of the Carpels when 2, and when single; including Outlines of a new Method of Arrangement of the Orders of Exogens, and Observations on the Structure of Ovaries consisting of a single carpel." Proceed. Linn. Soc. ii. 105.—"On the Position of the Raphe in Anatropal Ovules," *ibid.* p. 147.

† Theoria Systematica Plantarum: Lundæ, 1858.

is with the view of extending this inquiry that I have brought together these remarks.

It is evident from the foregoing exposition that the word *anatropal*, as applied to an ovule developed under a certain condition, is a very incorrect term, and one that might with propriety be abolished, because it serves to perpetuate a prevailing error; but it may still be retained if we limit its signification to a comparative instead of an active sense,—meaning, by the word *inverted*, a different position of the radicle in regard to the hilum in anatropal seeds—not as expressing any action of gradual inversion of the nucleus and its tunics, as has been assumed.

I will now proceed to show that the development of the raphe is always normally ventral, or next the placenta, and that when it assumes a dorsal position, this is due exclusively to a resupination of the entire ovule. I have already explained the difference in the incipient development of an anatropal and an atropal ovule—that in the former the pullulation of the nucleus is never from the extreme point, but always more or less removed from it, and in general completely on one side of the placentary sheath; this is either on the upper or the lower face, but sometimes lateral, and in these cases the growth of the ovule is either downwards or upwards, or laterally in regard to the axis of the ovary, producing thus either pendent, ascending, or laterally horizontal ovules. When the first appearance of the nucleus is on the superior side of the funicular sheath, we have a pendulous ovule, with the raphe necessarily on the ventral side of the primine (as shown in the marginal figures in p. 19), in all cases where the point of its attachment upon the axis of the carpel is at any sufficient distance above the base of the cell to allow of its downward growth; but if this point of origin be contiguous to the base, then the downward extension of the primine, pressing against the bottom of the cell, causes the ovule to incline upwards gradually into an erect position (turning thus upon its funicle, as Mr. Brown first sagaciously demonstrated in the case of *Euonymus*), so that the ovule becomes completely reversed, with the raphe upon its dorsal face. In the same way, when the pullulation of the nucleus is upon the lower side of the funicular sheath, we have necessarily an ascending ovule with a ventral raphe, produced by the upward expansion of the sheath, as in the marginal figures, showing the first and two later stages of this growth, which prevails in all cases where the ovule has sufficient room to expand itself; but where this production of the funi-

Figs. 8–10.

cular support is close to the summit of the cell, then the pressure of growth causes the ovule to be forced round gradually upon its funicle till it becomes pendent, with its raphe in a dorsal position. In both these instances of resupination of the ovule, there is no removal of the mouths of the tunics from their close contiguity to thetelæ conductrices,—a very important feature in the history of its development. These two conditions of growth of the placentary sheath may be expressed by the terms *epipyla* and *hypopyla*,—the former from ἐπὶ *super*, πύλη *porta*, where the first development is upwards; and the latter from ὑπὸ et πύλη, where it shows itself on the lower side of the sheath. In the first condition (where the micropyle points upwards), we have an *ovulum anatropum epipylum*, or a pendent ovule with a ventral raphe; but where the same ovule becomes inverted by pressure, we have an *ovulum epipylum resupinatum*, or an ascending ovule with a dorsal raphe. Under the second condition (where the micropyle points downwards), we have an *ovulum anatropum hypopylum*, or an ascending ovule with a ventral raphe; but when this becomes inverted by pressure, it is an *ovulum hypopylum resupinatum*, or a pendent ovule with a dorsal raphe. It often happens, where numerous ovules issue from a placenta of limited extent, that we have erect, horizontal, and pendent ovules all crowded together, some with a ventral, others with a dorsal raphe; but it will be found that all are equally epipylous or equally hypopylous, the one series showing their raphes in their normal position, the second intermediately placed, while the third, by their resupination, have a dorsal raphe. Under the third condition, where the ovules are in collateral pairs, and where the earliest appearance of the nucleus is upon the lateral face of the placentary sheath, the raphes face one another, whether the subsequent direction of the ovule, by the pressure of growth, be pendent, horizontal, or ascending: this kind of development may be called *allopylar* if in a single ovule, and *heteropylar* when in collateral pairs.

Another consideration worthy of attention in the development of the ovule, is the position of the embryo in regard to the seminal tunics,—that is to say, whether one of the faces of the cotyledons, or whether its margins be placed opposite the raphe: this point has seldom been regarded, except where the embryo is amphitropal or campylotropal, in which cases this position is known, from the radicle being said to be incumbent or accumbent in regard to the cotyledons. This relative position is often a constant feature in certain families, while in others it is subject to much variation, as in *Rhamnaceæ*; and the character is even sometimes variable in the same genus, as in *Rhamnus*. The position of the face of the cotyledon in regard to the axis of the

ovary is a feature very distinct from that of its relation to the raphe; and the two should not be confounded together: thus in *Rhamnus catharticus* the raphe is dorsal, both with respect to the axis of the ovary and to the embryo; in *R. chlorophorus* it is dorsal with regard to the embryo, but lateral as respects the axis of the ovary. In most instances throughout the *Rhamnaceæ* the embryo is incumbent with respect to the ovary, one of its cotyledons being posterior, the other anterior, in regard to the axis; but it is accumbent in regard to the raphe, which skirts the margins of the cotyledons. In *Berchemia* the cotyledons are incumbent, both with regard to the ovary and to the dorsal raphe.

In this investigation, I have noticed only the proper integuments of the ovule, leaving out of consideration that coating which, after impregnation, frequently grows over the primine and produces in the seed either an incomplete or an entire tunic, called an *arillus*. Schleiden and others are of opinion that the true aril must necessarily be pervious at its extremity, and he concludes (*l. c.* p. 431) that wherever an actually closed structure surrounds the seed, it is undoubtedly a layer of the seed-coats: but this is mere opinion unsupported by proof; for it is equally probable that the aril may become closed just as much as the proper tunics of the ovule. It has also been thought that it must necessarily be fleshy; but I have shown* that it is often perfectly entire, and frequently hard and testaceous (as in *Canellaceæ*, *Winteraceæ*, &c.), in which case the true testa, or development of the primine, is generally either fleshy or membranaceous, contrary to its usually hardened condition.

Where, on the other hand (as in *Magnolia*, *Clusia*, &c.), the inner tunic of the ovule becomes hardened by osseous deposits, the primine, as in the former case, remains fleshy, and assumes the appearance of a complete arillus, for which reason I proposed to call it an *arilline*† instead of testa, to which name the hardened tunic is more entitled. It has been contended by Dr. Asa Gray that the osseous tunic and the aril-like covering which contains the cord of the raphe are both developed from the primine, the former resulting from hardened deposits upon its inner layers of cells, while the outer cells remain soft and fleshy. I have argued that, if such a deposition took place in the manner stated, these two dissimilar textures must be enclosed by a single epiderm and one endoderm; but we find, on the contrary, each of the tunics provided with its respective external and internal epidermis, showing that the two formations are independent in their origin. It is also clear, that if these

* Ann. Nat. Hist. 3 ser. ii. 39; Contributions to Botany, i. 128.
† Trans. Linn. Soc. xxii. p. 89.

two coatings, so very dissimilar in their nature, were produced from a single ovular tunic, then the cord of the raphe ought rather to be found in the nut, as that would correspond with the inner layers of mesodermic tissue in which the raphe exists in the primine; whereas that cord of vessels is really imbedded in the fleshy tunic, while the nut is free from vessels of any kind. This is further shown in the general structure of the seed of *Magnolia*, where the raphe passes in its usual course through the tissues of the fleshy coating, from the base to the apex, when it suddenly breaks through the endoderm, and arrives at a distinct foramen in the chalazal extremity of the nut, which I have called a diapyle, through which it passes, and soon becomes lost in the thickened areole or chalaza of the inner integument.

On the other hand, we may conclude either that the nut originates in a development of the secundine, and that the tegmen results from the tercine or membrane of the nucleus (which is a very rational inference), or that the nut is of independent origin (which is still within the range of probability). Indeed there is nothing to prevent the possibility or probability of the formation of an intraneous coat between the usual tunics in the growing seed, subsequently to the closing of the micropyle of the ovule. We frequently meet with a copious deposit of loose cellular tissue between the testa and tegmen, or even between the latter and the albumen; and this deposition may become consolidated into a distinct membrane, or hardened by solid deposits: wherever there exists a budding-point, this may at any time take place. We have proof of the actual formation of such a tunic between the primine and secundine in the *Gnetaceæ**; and this, if applied to the case of *Magnolia*, points to a far more probable cause for the appearance of the hard tunic in the seed, than the improbable suggestion of Schleiden and Gray, to which I have just referred.

Schleiden, although entertaining so many ideal fancies respecting developments, gives nevertheless a somewhat true account of the present state of our knowledge on this subject: he says (*l. c.* p. 427)—"A greater confusion than that which prevails in the theory of the seed-coats is scarcely conceivable; the most heterogeneous things are thrown together under one name; thoroughly identical ones are placed in different kinds of organs; and there is nothing for it, if we would not make greater confusion, but to cut the thread and begin over again: the epidermis of the seed is sometimes described as testa, sometimes as arillus; seed-membranes are introduced where no true integuments exist."

* According to the interesting details given by Griffith, Lindley's 'Vegetable Kingdom,' p. 233, where analytical figures demonstrate the fact.

My object in bringing together the facts related in the foregoing pages is to show that we may always proceed with some degree of certainty, if we never lose sight of positive, invariable landmarks. Beyond doubt the surest course is to trace the developments from the earliest growth of the ovule to the final perfection of the seed; but where this cannot be done, notwithstanding the variable texture and condition of the tunics developed from the growth of the primine and secundine, we may always, with much confidence, by attending to the unerring indications afforded by the raphe, generally deduce the true nature and origin of the different coatings of seeds in Phanerogamous plants.

III.—*On* Dracunculus *and Microscopic* Filaridæ *in the Island of Bombay.* By H. J. Carter, Esq., Bombay.

[With three Plates.]

In the month of October 1853, I published a "Note" on *Dracunculus* in the island of Bombay*, and in February 1858 communicated additional "Observations" on the same subject†, in order to correct and complete it. My object in the first communication was to give an anatomical description of the Guinea-worm of this island; to compare it and its young one with that microscopic species of the Filaridæ which is most common in the freshwater tanks here, to which I have applied the name of "Tankworm;" to try to account for the origin of *Dracunculus*; and to suggest some prophylactic measures for its prevention. This led me to a further study of the microscopic species, both in the fresh and brackish or salt waters of the island, which again threw my attention back upon *Dracunculus*, and has finally ended in making me acquainted, not only with much more of the anatomy of the latter, but with nearly the whole of the organology, formation of the ova and spermatozoa of the Tankworm, as well as with several other microscopic species, all of which are interesting in various ways, but of which I have not been able to obtain much more than the external forms.

In my last communication, viz. the "Observations," I gave a short summary of the latter researches; and I now propose to give the full paper, with illustrations.

It may be conceived, perhaps, that much has been written on the Guinea-worm, and that publishing anything more about it is superfluous; but what has been written is very little to the purpose, and it is for this reason that it is desirable to record a

* Transactions Med. and Phys. Soc. Bombay, No. 2. p. 45, new series.
† Annals, vol. i. p. 410, 1858.

connected, exact, and complete description of it—which does not now exist. Besides, this could never have been acquired without a study of the microscopic Filaridæ which are to be found in the waters of the locality; while this study, again, has elicited facts which will be found acceptable both in physiology and natural history generally. Advantage also has been taken of the anatomy of the young Guinea-worm to confirm the existence of what otherwise might be doubted in the adult; and this, again, has afforded means of comparing the latter with the anatomy of the Tank-worm, for the purpose of pointing out the great resemblances between the two, and accounting for the modifications in form, &c., of *Dracunculus*, which appear to be induced by the circumstances under which it is developed.

The illustrations are numerous, and comprise, in the first plate, those of *Dracunculus*; the second plate is entirely devoted to a typical display of the organology, ovology, and spermatology of the microscopic species called the "Tank-worm;" and the third contains the forms of most of the other microscopic Filaridæ which have been observed. All the representations have been drawn after nature with great care, but with a leaning towards mathematical accuracy which renders them stiff and formal, though not the less effective for demonstrating the facts which they are intended to record.

I shall first describe the form and anatomy of *Dracunculus*, and then go to that of the Tank-worm; after which the other species of microscopic Filaridæ will be given, with some observations on them generally; and lastly, the whole considered with reference to the origin of *Dracunculus*.

The species of *Dracunculus* which occurs in the human subject in the island of Bombay, and probably in all India, is that which has been called "*Filaria Medinensis*," or "Guinea-worm;" and under this appellation it will be henceforth designated.

Filaria Medinensis, Gmel. Pl. I. fig. 1.

Female. Long, narrow, cylindrical, of equal size throughout, except towards the extremities, which are slightly attenuated. Smooth, white or colourless, unstriated transversely to the unaided eye, presenting two transparent and two opake lines running throughout the body, corresponding to the muscular bands and their intervals respectively. Anterior extremity or head (fig. 4) obtuse, round, furnished with two papillæ which are scarcely visible to the unaided eye, presenting, under a high microscopic power, a punctiform hole or mouth in the centre, surrounded by a smooth-bordered quadrangular space, on each side of which is a papilla, two of which papillæ are large and prominent, viz. those first mentioned, and situated above and

below the mouth respectively, while the other two are flat, rudimentary, and situated laterally. Besides this, there is another kind of armature extending from the rudimentary papillæ upwards and downwards, so as partly to encircle the head; but this is too faintly marked to require further notice; while the whole is fixed upon a kind of disk of concentric (muscular?) fibres, which is situated beneath the integument, and thus terminates this end of the body. From the four papillæ, which are situated at right angles to each other, as many whitish lines are seen to extend backward, of which those from the large papillæ pass into the centre of the muscular bands, where they are continued on faintly throughout the body, while those from the rudimentary papillæ pass into the transparent intervals between the bands. Thus, assuming that the opake bands, which are the great longitudinal muscles, are placed (as in *Ascaris lumbricoides*) above and below the alimentary canal, the large papillæ, being opposite them, will be vertically, and the rudimentary ones laterally situated, as before mentioned.

On the other hand, the posterior extremity (fig. 5) also appears obtuse to the unaided eye; but this, under a common magnifier, is observed to arise from an inflexion of the tail, which, being marked on its outer and inner curvature respectively by the great longitudinal muscles of the body, and the latter also by the termination of the rectum (*n*), as will presently be seen, may be assumed to be curved *ventrally*, where it is frequently fixed by an adventitious membrane (fig. 5 *o*). The anal orifice, as we shall also presently see, must be situated at the commencement of the tail, if the rectum has any opening at all externally, which I think very doubtful, as I have not yet been able to discover it; nor have I ever been able to see any trace of a vaginal opening or vulva.

The body consists of a firm cylindrical integument lined with a coating of muscular fibres, within which, again, loosely suspended by delicate filaments of cellular tissue in the peritoneal cavity, are the alimentary canal and generative organs.

Integument homogeneous, transparent though coriaceous.

Muscular coat consisting of some delicate circular fibres, which appear to be attached to the integument, and the two longitudinal muscular bands before mentioned, which are assumed, in accordance with what has been stated of *Ascaris lumbricoides*, to be respectively situated dorsally and ventrally. Peritoneal cavity empty, presenting towards each extremity a patch, about an inch long, of sarcoid (glandular?) prolongations, which are most marked anteriorly.

Alimentary canal (fig. 3) consisting of the œsophagus, intestine, and rectum, of which the two former are in a common

sheath divided by a constriction opposite their point of union. Œsophagus (*a*) straight, narrow, about 1-600th of an inch in diameter, commencing at the oral orifice and extending backwards for about two inches, where it becomes slightly dilated, and then joins the intestine; surrounded by the common or peritoneal sheath, within which again is the muscular one, both together forming a cylinder about 1-76th of an inch in diameter. Intestine (*b b*) much wider than the œsophagus, uniform in calibre, pursuing within its peritoneal sheath a tortuous course throughout the peritoneal cavity from being more or less twisted round the ovisac, and terminating almost close to the tail, in the rectum (*c*). Rectum only 1-8th of an inch long, without sheath, passing into the ventral muscular band or the inner curvature of the tail, beyond which I have not been able to trace it; that is to say, I have been unable to detect its connexion with an anal orifice in the integument over its termination, even under very favourable circumstances for examination, so that if there be any aperture of this kind at all, it must be extremely minute. Peritoneal sheath of the intestine the same or less in width than that of the œsophagus, which thus occasionally makes the intestine look less in diameter than the œsophagus, commencing from the constriction opposite the union of the œsophagus and intestine, and continued throughout of uniform diameter to the rectum. Hepatic organ consisting of a layer of brownish oil-globules which occupies the interval between the intestine and its sheath throughout, or probably terminating a little short of the end of the intestine, as shown in the young *Dracunculus* (fig. 6 *f*), where that which is not easily seen in this respect in the adult is supplied at once.

Organs of Generation (fig. 2). These consist of a large single ovisac (*b*, *b*), terminated by an ovary or small ovarian tube at each extremity. The ovisac uniformly cylindrical throughout, about 1-24th of an inch in diameter, and occupying the greater part of the peritoneal cavity, extending to within an inch and a half of each extremity; membranous, without trace of constriction or projection in any part of its course, and terminating abruptly at each end in a narrow blind tube (the ovary), about an inch long, which is slightly dilated at its extremity. It is the abrupt termination of the ovisac a little short of the ends of the Guinea-worm which makes these parts of the latter more transparent than the rest of the body. The ovisac is filled with young Guinea-worms (all of which are of the same size) and some granular matter. An ovisac 26 inches long and 1-24th of an inch in diameter, which is about the average size in the adult Guinea-worm, should, if filled with young of the size to be hereafter mentioned, which is generally the case, contain upwards of half

a million. I have never seen any in capsules, or anything like the remains of capsules, though I think we may fairly infer that the granular matter is the remains of the embryonal envelopes, whatever these may have been.

There being no indication in the ovisac of any connexion with a vagina, and no vaginal orifice to be found externally, it might naturally be inferred that the ovisac could only obtain an exit by bursting through some part of the body, and that, as it is the head of *Dracunculus* which always protrudes first, this rupture is somewhere in its neighbourhood. To satisfy myself that such was the fact, I selected a case where the bleb which covers that part of the skin through which the head has ulcerated was unopened, and having carefully cut away the cuticle thus raised, saw the head of the Guinea-worm extruded for a line or two beyond the wound, when, on pouring some water over it, to see it more clearly, the ovisac immediately burst forth from it to the extent of an inch or more. I then carefully tied a piece of thread round the protruded part of the body of the Guinea-worm as far back as possible, and having prevented its retracting by drawing it out a little and placing another ligature beyond this, severed the worm between the two ligatures, and took away the head for microscopical examination. On proceeding with the latter, I found that the ovisac had passed out through a *distinctly* ruptured hole, which was situated 1-160th of an inch from the head; and knowing that no aperture exists here naturally, there could no longer be any doubt that the rupture had been occasioned by the distended ovisac, rendered much more so perhaps at the moment by the imbibition of the water which was poured over the wound just before the rupture took place.

Size. I have never yet measured a Guinea-worm which was beyond 32 inches in length, and, when fresh and fully distended, about 1-9th of an inch in breadth. This I should regard as the maximum size in Bombay; but they may be of all lengths below this.

Male. Not seen by myself. Professor Owen has figured one with an inflated, round, posterior extremity, and a single spiculum projecting from the apex, of which he states, "The caudal extremity of the male [*Filaria Medinensis*] is obtuse, and emits a single spiculum."

Young Dracunculus. Plate I. fig. 6.

Microscopic, filiform, minutely striated transversely, slightly diminishing towards the head, which is obtuse, tapering towards the tail, which is very long and whip-like; presenting a slight inflation at the root of the tail, to accommodate a glandular organ of the interior; head without papillæ; mouth punctiform,

in the centre of the anterior extremity; no vulva; anal orifice at the root of the tail. Alimentary canal commencing with a narrow, rigid œsophagus, ending in a much wider intestine, which is continued straight through the body, of uniform calibre, to the rectum, which is short, narrow, and proceeds obliquely to the anus. Œsophagus surrounded by a muscular sheath, and probably a peritoneal one; but the latter is not seen *in situ*, and the parts are too delicate to admit of its being demonstrated by their forcible expulsion, as in the adult, where it is also not visible *in situ*, but becomes evident when the œsophagus has followed the ovisac on its bursting through the body: thus the peritoneal sheath of the œsophagus would appear to be undistinguishable in both instances *in situ*, from being in contact with the muscular sheath, while in some of the microscopic Filaridæ it is separated by a distinct interval (Pl. III. figs. 29, 30). Peritoneal sheath of intestine continued from the constriction opposite the union of the œsophagus and intestine to the commencement of the rectum, where it terminates. Hepatic organ consisting of a layer of yellowish oil-globules, which occupies the interval between the intestine and its sheath from the œsophagus to within a short distance of the rectum, where it disappears and leaves the rest of the intestine only covered by the peritoneal sheath (fig. 6 *f*). Organs of generation undeveloped; no vulva. Size 1-33rd of an inch long and 1-633rd of an inch broad.

Obs. The transverse striæ are far more marked in the young than in the adult *Dracunculus*, where they are but just perceptible under a high microscopic power, and appear to be identical with the transverse muscular fibres, while in the young *Dracunculus* they are evidently corrugations of the integument.

Urolabes palustris, n. s. Pl. II. fig. 7.

Female. Linear, cylindrical, smooth, white or colourless, unstriated transversely, gradually diminishing towards the head, which is obtuse and terminated by a distinct labiate portion, furnished with at least two, if not four, indistinct papillæ; diminishing abruptly towards the tail, which is attenuated and whip-like. Mouth in the centre of the anterior extremity. Vulva a little in front of the middle of the body. Anus at the root of the tail.

Integument transparent, tough, apparently structureless, lined by a muscular coat, which only becomes visible under protrusion, when the former is ruptured. Muscular coat circumscribing the peritoneal cavity, presenting on its inner surface lines of oil-globules, and towards each extremity sarcoid glandi-

form prolongations, as in *Dracunculus*. The latter is a common feature in all the microscopic Filaridæ that I have examined.

Alimentary canal loosely suspended within the peritoneal cavity, consisting of an œsophagus, intestine, and rectum, of which the two former are ensheathed, and the latter naked. Œsophagus commencing with a cup-like or buccal cavity, into the posterior part of which projects a sharp-pointed, horny, narrow tube (fig. 11 *d*), which is continued backwards in a straight line to the intestine, and is exsertile at the oral orifice. Intestine much longer than the œsophagus, uniform in size, and passing straight through the body to terminate abruptly in the rectum, which is very narrow, short, and pursues an oblique course to the anus. Œsophageal sheath assumed to be double, consisting of a membranous (peritoneal) and a muscular portion, which are in contact with each other, and gradually increase in width from the mouth to the commencement of the intestine, where they are constricted, and the latter terminates, while the former is reflected on to form the peritoneal sheath of the intestine (*g*). The muscular portion has been wrongly called the œsophagus, while little or no notice has been taken of the horny tube which passes through its centre. The latter, which is also penetrating, is at once the organ of suction and that through which the nutriment is conveyed back to the intestine. I have seen drops of oil (the food) pass out of the point of this, under pressure, but never any trace of food in the sheath which surrounds it. Whether the horny tubular portion be again surrounded by a membranous tube, and thus form a kind of proboscidian organ, I have not been able to determine any further than the buccal dilatation goes, from which it is evidently separate; but it seems to me not improbable that this may be the case throughout, and that this tube may be moved backwards and forwards by a muscular apparatus in the bulbous part of the muscular sheath (see Pl. III. figs. 25, 26, and 27 *c*). But of this there is no doubt, that it or its immediate enclosing sheath is the only part which is in continuation with the intestine (fig. 11 *h*). Peritoneal sheath of intestine uniform in calibre throughout, or until it arrives within a short distance of the rectum, where it suddenly becomes smaller from the absence of the hepatic organ (fig. 7 *f*), and continues thus for some distance until it arrives at the rectum, where, like the intestine which it surrounds, it also abruptly terminates.

Hepatic organ consisting of a layer of yellowish-brown oleaginous globules, becoming amber-coloured posteriorly, occupying the interval between the intestine and its sheath, and extending from the commencement of the former to the part where the sheath becomes suddenly smaller, where they cease, or are only

sparsely scattered in groups (in cells?) over the remaining portion.

Posterior part of the intestine, which is sparsely covered with hepatic globules, presenting an irregular rhythmical influx and expulsion of water through the rectum, like that observed in some Naïdina, where it is produced by cilia for the influx, and by contraction of the intestine for expulsion.

Organs of Generation (fig. 8). Double, cylindrical, symmetrical, occupying the middle half of the body, each half consisting of an ovary and ovisac inflected upon the other part, which is the oviduct or fallopian tube. Ovary and ovisac continuous, formed of a delicate, membranous, pyramidal tube, blind at each extremity, and lying longitudinally in the peritoneal cavity, with the pointed or ovarian extremity towards the vulva, and the larger portion or ovisac in the opposite direction. Fallopian tube thick, muscular, arising from the ovisac at a little distance from the large extremity of the latter, which is thus rendered cæcal (figs. 8 *c* and 13 *d*), and presenting one or more constrictions and dilatations in its course towards the vulva, where it becomes suddenly narrowed and, uniting with its fellow of the opposite side, forms the vagina. Ovary and ovisac filled with ova in successive stages of development, up to the junction of the fallopian tube, beyond which they do not extend, the cæcal extremity being filled with a muco-granular matter only. Dilatations of the fallopian tube filled with spermatozoa (each of which is enclosed in its respective cell), and a greater or less number of ova, extending in single file up to the vagina.

Largest size 1-6th of an inch long and 1-370th of an inch broad.

Male (fig. 9). The same as the female, but smaller, and with the tail truncated almost close to the anus.

Organs of Generation (fig. 10). Double, occupying the middle half of the body, consisting of two cylindrical, delicate, membranous sacs of a pyramidal form, lying longitudinally in the peritoneal cavity, with their large ends approximated, each large end giving off a short narrow tube, which, becoming united, form a large seminal duct that is continued straight back to the neighbourhood of the rectum, where it terminates in a dilated portion, in the parietes of which are fixed two ensiform or scaphoid bodies of a horny consistence and yellowish colour, which together form the penis. These lie obliquely across the body, are thin, and curved longitudinally as well as transversely inwards, so that, when approximated at their pointed ends, they form a canaliculated, stiff, pointed, pyramidal, curved organ, which is exsertile at the anus.

Development of the Ovum (fig. 13). The ova first appear as a

mass of minute nucleated vesicles or cells occupying the pointed extremity of the ovisac, to which we have given the name of "ovary," and, gradually becoming larger with their distance from this point, at last come to occupy respectively an entire transverse portion of the tube, so as to form a single file of ova, which, divided by transverse straight lines, arising from the parallel approximation of their coats, thus cut the ovisac into graduated divisions, which increase in width as they approach the fallopian tube, where they end (*c*), the remaining cæcal portion being filled with the granular matter already mentioned, to which we shall direct our attention more particularly hereafter. Up to this point, the germinal vesicle and its nucleus, together with the yelk, are observed to be gradually increased in size, but not surrounded by more than one membrane, which is delicate, soft, and easily ruptured. The ovum now passes into the fallopian tube, which is filled with spermatophorous cells, each of which, as before stated, bears a single spermatozoon; and, as it traverses these, the germinal vesicle and its nucleus gradually disappear, and a second membrane, viz. the coriaceous coat, is added (*l*), when the ovum assumes an elliptical shape, and, arriving at the vagina, is laid before segmentation commences.

Development of the Spermatozoon (fig. 14). The spermatozoa are developed from minute nucleated cells which fill the small ends of the testicular sacs (*a*), which are in fact the testes, each of which cells consists of a cell-wall lined by a portion of protoplasm, in one part of which is the nucleus (fig. 15). The cell now increases in size, and a number of points or nuclei make their appearance in the endoplasm, thus giving it a granular appearance (16). These points or nuclei now enlarge, and each presents around itself a cell; during this process the whole mass has much increased in size, and the original nucleus may be assumed to perish (18). The endoplasm now gradually disappears, while the points or nuclei enclosed within their proper cells become larger and elongated, till at last nothing but a few fragments of the endoplasm remain, and the spermatophorous cells, which are indeed the daughter cells, are observed to be adherent to the inner periphery of the parent cell (19). At length the elongated nuclei with their cells force themselves through the parent cell, and, after remaining pendent to it for a short time, finally obtain their liberation, when the elongated nucleus of each cell is seen to be a spermatozoid (21). The spermatophorous cells thus liberated fill the large ends of the testicular sacs (14 *d*), and passing in this state into the seminal duct, are at length transferred from the male to the female, where, as before stated, they fill the dilated portions of the oviduct or fallopian tube (13 *g*, *k*). They are now observed to consist of a delicate, thin,

flexible cell, within which is the spermatozoon and a small fragment of granular matter, which, like that observed in the parent cell, appears to be the unemployed portion of the contents of the spermatophorous cell, which has not entered into the formation of the spermatozoon. The latter may now be seen to be writhing and twisting about in all directions, and giving a number of shapes to its cell as it forces it out in one direction and another (22), until it finally escapes, when it is observed to be linear, about 1-400th of an inch in length, consisting of a thick cephalic portion which is linear-fusiform and amounts to about two-thirds of the whole, and a thin, flexible, undulating portion which forms the other third, and is the tail (24). In this state it frequently appears among the contents of the testicular sacs, and always among those spermatophorous cells of the fallopian tube which are close to its junction with the ovisac.

According to this description of the development of the spermatozoa, it might be inferred that every spermatic or parent cell attains the same size, produces the same number of spermatophorous or daughter cells, and therefore each should contain a large number of spermatozoa; but such is not the case; for not only at an early period (that is, in the granular stage) are spermatic cells of different sizes to be seen, some of which are apparently filled with spermatophorous points (daughter cells in embryo), and others only containing two and three or upwards, indicating that the former will produce more than the latter (17), but at the end, when the whole of the endoplastic contents of the parent cell have become absorbed, with the exception of a fragment or two here and there, and the spermatozoa have nearly attained their full development, this is further confirmed by the presence of parent cells of different sizes containing from one to twenty spermatophorous cells (19). I therefore see no way of accounting for this variety in the size of the parent cell and in the contained number of spermatozoa, than by assuming that all the spermatic or parent cells do not develope the same number of spermatozoa, either from part of the granules or daughter cells becoming blighted, or from only a certain number being produced in the first instance. To endeavour to account for it by assuming that the *daughter cells* may develope one or more spermatozoa, and therefore that these may be the cells containing the few spermatozoa, would not be borne out by the contents of the few-bearing parent cells, which all present spermatophorous cells around their spermatozoa, while, if they had been daughter cells, the spermatozoa would have been all together, that is, not separated by a further cellular enclosure—an instance of which has never come under my observation.

The appearances presented by the contents *in situ* of the tes-

ticular sac, from its small towards its obtuse end, too, correspond with what they present when examined separately, after forcible expulsion (14). Thus, the small end is observed to be filled with small, delicate, nucleated cells (*a*); further on, these are much enlarged; then the mass presents a granular appearance, which becomes more marked progressively as the granules become larger (*b*); after which the granules assume an elongated form, which is the first sign of their being spermatozoa; radiated masses of spermatozoa now present themselves (*c*), and lastly, the mass of spermatophorous cells after they have left the parent cells, occupies the large end of the sac (*d*).

How the radiated arrangement is produced, I am unable to explain; for, up to the time of the spermatophorous or daughter cells leaving the parent cells, they appear to be disposed irregularly round the inner surface of the latter—at least such is their position after forcible expulsion (19 *d*). It is not uncommon, however, to see small parent cells containing a few spermatophorous cells with the spermatozoa radiating from one point (20 *a*); nor is it uncommon to see groups of spermatophorous cells without the parent cell, so attached together that all the heads of the spermatozoa are directed to one point (20); but on the other hand, as before stated, in the large parent cells, which contain a great many spermatophorous ones, they appear to be arranged irregularly round the periphery (18). If the large masses in the testicular sac (14 *c*) could be expelled entire, we might perhaps be able to see how this radiated arrangement is produced; but I must leave future investigation to point out this, and to explain why, in the larger cells, after forcible expulsion, they have not this arrangement, or whether they ever have it. Perhaps it is the forcible expulsion, after all, which destroys the radiated arrangement.

Again, as regards the spermatozoon: from possessing the form mentioned, which appears to be the normal one (24), many have the head of an intervening shape between bacilliform or linear and globular, but still always retaining the point or beak; while in the fallopian tube, sometimes, when the development of the ova appears to have ceased, and they have not been required, they are observed to have passed into still longer, bacillar, sharp-pointed bodies which have lost all vitality and become rigid and brittle.

Thus the development of the spermatozoa in their early stages corresponds exactly with what I have described and figured respecting their development in *Nais fusca**, that is, so far as the production of the granules or daughter cells in a nucleated parent cell is concerned, and these daughter cells becoming the sperma-

* Annals, series 3, vol. ii. p. 90, 1858.

tophorous ones; but here, in *Urolabes palustris,* while the development still goes on within the parent cell, and the spermatophorous cells adhere to its internal periphery, in *Nais fusca* the parent cell is lost, and the spermatophorous vesicles become fixed to a central albuminous mass until the spermatozoa are developed*.

The fact of the granules (which become the vesicles or daughter cells) being within the spermatic cells here, as well as in *Nais fusca*†, makes me doubt the interpretation which Dr. Nelson has given to their appearance in the testicle-sac of *Ascaris mystax,* where he states that the spermatic cells are met in their progress downwards through the testicular sac by a number of granules "which group themselves around" them, and continue about them until they get into the "uterus" of the female, where they drop off and form a "granular fluid," leaving the spermatic cells naked‡. As, however, my observations are based upon Dr. Nelson's statements, and not on actual examination of *A. mystax,* I will merely add, that the grouping of granules around the spermatic cell appears to me to be a phænomenon as inexplicable as it is anomalous.

That the spermatic cells themselves should be thrown off the inner surface of the testicular tube of *A. mystax* in "granules," I can easily conceive; but the impossibility of getting at the inner part of the end of the testicular tube in *Urolabes palustris,* left to the mere chance of the position it may take after bursting through the integument from pressure, and by moving the covering-slip of glass (for these parts are far too minute to be otherwise manipulated), is such, and the rapid imbibition of water by the cells situated there so distends the contents at the end of the tube, that it is impossible to ascertain anything satisfactorily beyond the fact that it does contain cells, and that these cells produce the spermatozoa. By a "granule" which passes into a nucleated cell here, I do not understand a simple aggregation of matter, but a point of complicated structure which we call a granule because its structure is too minute for us to demonstrate by the microscope.

Impregnation.—This appears to take place at the moment when the ovum reaches the mouth of the fallopian tube (13 *f*), and to require that the spermatozoon shall have left its cell before the incorporation can be accomplished,—1st, because the germinal vesicle and its nucleus appear full and prominent in the ovisac at this point, and disappear rapidly after the ovum has passed into the fallopian tube; 2ndly, because up to this time the ovum is without the coriaceous coat with which it afterwards

* Annals, vol. ii. pl. 3. † *Id.* pl. 2. fig. 5.
‡ Phil. Trans. p. 505, &c., 1852.

becomes rapidly invested, and therefore at this moment ready with its soft thin coat to admit the spermatozoa; and, 3rdly, because the spermatozoon does not become active within its cell until it arrives at this point, where it may be found in all stages of liberation, in addition to being actually liberated. Moreover, it might be inferred that the cell would form an impediment to the ingress of the spermatozoon, an obstacle to incorporation, and a deciduous product which the ovum could ill accommodate. Thus, as the cells of the spermatozoa are thrown off at this point, it is not improbable also that their remains form the muco-granular contents of the cæcal end of the ovisac, to which I have already alluded.

Hab. Fresh water, in tanks and dirty drains wherever there is vegetable matter, mud, and putrescency, and in the gelatinous Algæ during the "rains." Breeding from January, and perhaps earlier, up to the end of April, but apparently not after. Abundant throughout the year.

Loc. Island of Bombay.

Urolabes Glœocapsarum, n. sp. Pl. III. fig. 25.

Female. Linear, cylindrical, striated transversely, gradually diminishing towards the head, which is obtuse and without papillæ; also towards the tail, which is long and furnished with a digital termination. Mouth in the centre of the anterior extremity. Vulva a little anterior to the middle of the body. Anus at the root of the tail.

Œsophagus commencing with a cup-like buccal cavity, from which a narrow straight tube is extended back to the intestine. Intestine much larger than the œsophagus, straight, and of equal calibre throughout, abruptly terminating in the rectum, which is narrow and obliquely directed towards the anus. Muscular sheath of the œsophagus commencing a little distance from the buccal dilatation, so as to leave a portion of the œsophagus naked, and, increasing in size backwards, presenting at first an oval and then a bulbous dilatation, after which it becomes constricted opposite the union of the œsophagus with the intestine. Intestinal sheath commencing with the intestine, and ending at the rectum. Hepatic organ consisting of a layer of brownish oil-globules occupying the interval between the intestine and its sheath throughout.

Organs of generation double, occupying the middle third of the body, as in the foregoing species; their form undetermined.

Size. 1-54th of an inch long and 1-376th of an inch broad.

Male. Somewhat smaller than the female; tail somewhat shorter and thicker; testis in the centre of the body, its form

undetermined; seminal duct and penis as in the foregoing species; penis exsertile at the anus.

Hab. The *Glœocapsa* which grows on walls and on the sides of gutters during the "rains."

Loc. Island of Bombay.

Urolabes labiata, n. sp. Pl. III. fig. 26.

Female. Linear, cylindrical, unstriated, gradually diminishing towards the head, which is labiated and furnished with two papillæ; also towards the tail, which is conical and elongated. Mouth in the centre of the anterior extremity. Vulva much behind the centre of the body, about the point of union of the posterior two quarters. Anus at the root of the tail.

Alimentary canal and œsophageal and intestinal sheaths, with hepatic organ, the same as in the foregoing species, but no buccal dilatation. Organs of generation apparently the same, but probably unsymmetrical, there being no room for the posterior half, on account of the backward situation of the vulva; their form undetermined.

Size. About 1-40th of an inch long and 1-774th broad.

Male. Unseen.

Hab. The *Glœocapsa* of the walls, &c., during the "rains."

Loc. Island of Bombay.

Urolabes tentaculata, n. sp. Pl. III. fig. 27.

Female. Linear, cylindrical, unstriated, gradually diminishing towards the head, which is obtuse and furnished with two short, thick, conical, tentacular prolongations, closely approximated at their base and turned outwards; also diminishing gradually towards the tail, which is conical and elongated. Mouth and anus as in the foregoing species. Vulva just behind the middle of the body.

Alimentary canal and œsophageal and intestinal sheaths, with hepatic organ, much the same as in the foregoing species, but no buccal dilatation. Organs of generation double, occupying the central portion of the body, their form undetermined.

Size. About 1-23rd of an inch long and 1-26th [?] of an inch broad.

Male. Unseen.

Hab. The same as the foregoing species.

Loc. Island of Bombay.

Urolabes cirrata, n. sp. Pl. III. fig. 28.

Female. Linear, cylindrical, unstriated, gradually diminishing towards the head, which is obtuse and furnished with two linear short cirri widely separated; also diminishing gradually to-

wards the tail, which is somewhat curved and obtuse at the extremity. Mouth and anus as in the foregoing species. Vulva in the posterior half of the body, a little in front of the union of the posterior two fourths.

Alimentary canal the same as in the foregoing species, but without buccal dilatation; the œsophageal sheath commencing close to the oral orifice, and gradually increasing in diameter backwards to its bulbous termination. Organs of generation undetermined.

Size. 1-73rd of an inch long and 1-1080th of an inch broad.

Male. Unseen.

Hab. Same as foregoing.

Loc. Island of Bombay.

The next species are all from salt or brackish water in the marshes of the island of Bombay.

Urolabes erythrops, n. sp. Pl. III. fig. 29.

Female. Linear, cylindrical, minutely striated transversely, ocellated, gradually diminishing towards the head, which is obtuse and without papillæ; also towards the tail, which is long and conical. Mouth and anus as in the foregoing species. Vulva just about the middle of the body.

Alimentary canal much the same as in the foregoing species. Œsophagus commencing with a cup-like, followed by a globular dilatation, after which it becomes narrow, uniform in width, and pursues a straight course back to the intestine. Peritoneal and muscular sheaths of the œsophagus distinct from each other. Intestinal sheath presenting a constriction just after its commencement, which gives it a globular form, part of which only is lined with the hepatic organ. Hepatic organ the same as in the foregoing species. Organs of generation double, occupying the middle third of the body; form undetermined.

Ocelli consisting of two globular bodies situated a short distance from the head, and between (?) the peritoneal and muscular sheaths of the œsophagus, opake, of a rich carmine colour in their posterior three-fourths, and the anterior fourth or corneal portion bluish opalescent.

Size. 1-20th of an inch long and 1-470th of an inch broad.

Male. The same as the female, but with the posterior part of the body terminating more abruptly and the tail more attenuated. Testis, seminal duct, and penis the same as in the foregoing species; form of the testis undetermined.

Hab. Silty clots of *Oscillatoria* floating in the salt-water main drain of the town of Bombay.

Loc. Island of Bombay.

Urolabes infrequens. Pl. III. fig. 30.

Female. The same as in the foregoing species, but a little larger in every way.

Alimentary canal and organs of generation the same generally. Ova undergoing segmentation and the embryo developed in the ovisac, but not liberated there.

Ocelli the same in situation, but semi-opake and of a yellowish colour throughout.

Size. Undetermined.

Male. Same as the female, but with a short curved tail, presenting on each side of the inner curvature a membranous expansion supported on setaceous ribs, which extends from the tip of the tail to some little distance above the anus. Organs of generation the same as in the foregoing species; form of testis undetermined.

Hab. Same.

Loc. Island of Bombay.

Urolabes ocellata, n. sp. Pl. III. fig. 31.

Female. Linear, cylindrical, unstriated, ocellated, diminishing gradually towards the head, which is obtuse and provided with four short linear cirri; also diminishing gradually towards the tail, which is short, somewhat curved, and furnished with a pointed digital termination. Mouth, vulva, and anus situated as in the foregoing species.

Alimentary canal the same, but with the œsophageal sheath more bulbous posteriorly, and no globular dilatation of the intestinal sheath posterior to it. Hepatic organ the same.

Ocelli the same as in *U. erythrops*, but smaller, less rich in colour, and a little nearer the head.

Size. About 1-32nd of an inch long.

Male. The same as the female, with the exception of the difference in the generative organs, which are the same as those of the foregoing species; form of testis undetermined.

Hab. Same.

Loc. Island of Bombay.

Urolabes barbata, n. sp. Pl. III. fig. 32.

Female. Body the same as the last, but much longer. Head furnished with four linear, short cirri. Tail short, somewhat curved, furnished with a short, pointed, digital termination. Mouth and anus the same. Vulva situated much posteriorly to the middle of the body, about the junction of the middle with the anterior third of the posterior half.

Alimentary canal the same as in the foregoing species, but the intestinal sheath terminating less abruptly upon the commence-

ment of the rectum. Hepatic organ the same. Organs of generation double, occupying the middle part of the body; their form undetermined. *Ocelli* at some distance from the head, of the same colour as in *U. infrequens*.

Size. 1-7th of an inch long and 1-600th of an inch broad.

Male. The same as the female, but with a large, thick, curved tail, obtuse at the extremity, tuberculated in its inner curvature, and furnished on each side with a row of short setæ extending from above the anus towards the tip; also three or four setæ on the outer curvature. Testis and penis the same as in the foregoing species; form of the testis undetermined.

Hab. Same.

Loc. Island of Bombay.

Urolabes parasitica, n. sp.

Female. Linear, cylindrical, unstriated, gradually diminishing towards the head, which is obtuse and without papillæ, and also towards the tail, which is long and conical. Mouth and anus as in the foregoing species. Vulva a little in front of the middle of the body.

Alimentary canal and hepatic organ the same. Œsophagus commencing in an expanded oral orifice, immediately becoming narrowed into a straight uniform tube; naked at the commencement, but soon surrounded by a sheath, which goes on increasing in width to the point of union of the œsophagus and intestine, after which it continues of uniform calibre to the termination of the latter. Organs of generation double, occupying the middle third of the body, their form undetermined; filled with ova diminishing in size with their distance from the vulva, and all presenting the germinal vesicle.

Size. 1-43rd of an inch long.

Male. Unseen.

Hab. Peritoneal cavity of *Nais albida*, in more or less abundance during the "rains," when this *Nais* makes its appearance in the *Glœocapsa* mentioned.

Loc. Island of Bombay *.

[To be continued.]

IV.—*On the occurrence of a Fish* (Pteraspis) *in the Lower Ludlow Rock*. By J. W. Salter, F.G.S.

The discovery of a true Fish in beds of the Silurian system considerably older than the famous "bone-bed" of the Upper Ludlow rocks is a fact of much interest. It is desirable at once

* For a small figure of this worm, see 'Annals,' series 3, vol. ii. pl. 4. fig. 50.

to make it known, the more so as *all* previously-described fishes from the Silurian system, other than those of the very topmost layer (the bone-bed), have, when carefully examined, turned out to be something else than fish. Zoophytes, Trilobite-fragments, plates of Cystidean animals, the tail-spines of Crustacea, even worm-burrows and scales of black mica, have all been mistaken for fragments of fish-bones or scales, and have some of them figured even in general works. The only undoubted specimen (a fish-palate) was described from rocks of the age of the Dudley limestone; but this has proved to be a Carboniferous species*, and was most probably introduced by accident into the quarry of older rock, among the debris of which it was picked up.

It is therefore a matter of real interest to find at length a true Vertebrate down in the mud-stones of the Lower Ludlow rock, many hundred feet below the bone-bed. The position of the fossil is unquestionable; its place has been determined by one of the most persevering of our local geologists, Mr. Lightbody of Ludlow, who (in company with Mr. Lee of Caerleon) found it, and in whose collection the gem remains; and it has been verified by others, the Rev. W. Symonds of Pendock especially, who, as well as myself, has seen the quarry, and knows well that these flat-bedded strata belong to the Lower Ludlow, are full of the characteristic fossils, and are regularly surmounted by the Aymestry limestone and the Upper Ludlow rock.

The place of the fossil thus secure, its structure is the next point of importance; and those who have read the memoir on *Pteraspis* in a late volume of the 'Quarterly Geological Journal †' will be satisfied with the statement that both the prismatic inner or second layer, and a good deal of the outer striated layer, are preserved on this nearly complete dermal plate—the portion usually preserved, and which was shown, at the last Meeting of the British Association ‡, to lie immediately behind the head, on the dorsal surface.

Description.—This nuchal plate shows a very similar form and striation to that of *Pteraspis truncatus* § from the topmost layers of the Ludlow rock (or Downton sandstone), but it is longer and narrower, and of much less depth and convexity. This is not due to pressure; for an Upper Ludlow specimen, undistorted, has the same characters. The general form is a long oval, with the ends truncated; the front is slightly emar-

* *Cochliodus aliformis*, M'Coy. See Quarterly Geol. Journal, vol. vii. p. 266. figs. *a*, *b*, *c*.

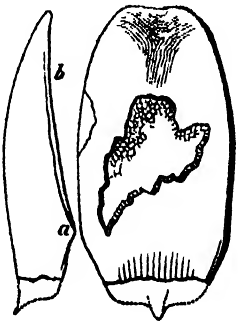
† Prof. Huxley, in vol. xiv. p. 267, &c.

‡ *Id.* in Rep. Brit. Assoc. for 1858, Trans. Sect. p. 82.

§ See Banks in Quart. Geol. Journ. vol. xii. pl. 2. f. 1.

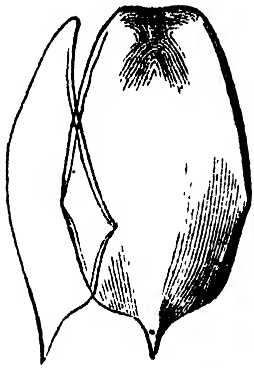
ginate; the posterior end (not perfect in fig 1, but nearly so in the Upper Ludlow specimen*) has an obtuse short keel, but is

Fig. 1.



P. ludensis.

Fig. 2.



P. truncatus.

Outline-diagrams of *Pteraspis*. The figures are not strict drawings, but intended to point out the distinguishing characters of the two species.

not prolonged, to all appearance, into a spine, as in *P. truncatus*; nor is the posterior margin nearly so oblique. The fragment is sufficiently perfect to show this. The lateral angle *a*, which terminates the bevelled sutural edge *b*, is further back in the new species.

Besides the narrower form, there is a decided difference in the direction of the sculpturing. In *P. truncatus* (fig. 2) the striæ and also the stronger intermediate ribs *converge* posteriorly towards the ridge and spine, and again anteriorly towards an obscure median line. In this species, on the other hand, they start more parallel from the posterior margin, and near the anterior end *diverge* towards the outer angles. So far as the preservation of the specimen permits of judging, there are no stronger striæ anteriorly.

As there seem to be sufficient characters to distinguish the species, it will be well not to confound it with *P. truncatus*, to which it was doubtfully referred in the second edition of 'Siluria†.' It may be called

P. ludensis, n. sp.

P. scuto nuchali elongato, oblongo-ovali, convexo nec gibbo, antice truncato etiam emarginato, postice brevicarinato haud longispi-

* It is added in dotted outline to fig. 1.

† Page 267. It is mentioned as probably distinct, in the note on *Pteraspis* appended to Mr. R. Banks's paper, before quoted. This referred only to the Upper Ludlow specimen with an incomplete surface.

noso; superficie lineis subrectis antice divergentibus tenuissime striata.

Localities. Lower Ludlow Rock, Leintwardine, with shells, star-fish, and large species of *Pterygotus* (fig. 1, Mr. Lightbody's Collection; found in 1859). Upper Ludlow Rock, Ludlow (in Mr. J. Harley's Collection, found in 1852).

Of the true piscine nature of the species just described we have clear evidence in the existence of all the three layers of bone described by Prof. Huxley in his memoir. With regard to the *P. truncatus*, which is less perfectly preserved, the inner layer has not yet been observed; but in the structure and ornament of the two outer ones—the general form, lateral angles, and bevelled sutural edges—there is the closest resemblance to *P. ludensis*. The Crustaceans of the same rocks have a different ornament, and, it is needless to say, no bony structure.

What the relative standing of these very ancient Cephalaspid fish may be, is a point yet to be decided; but it is at least worthy of note that the range of fishes a little further backward in time is established by the discovery, not of new types, but of new species of a genus and group proper to the lowest beds of the overlying formation, and characteristic of these beds. In the same way, the giant *Pterygoti*, long known in the Old Red Sandstone, have now been traced downward in diminishing numbers, and of new species, through all the Upper Silurian beds. Again, a Pteropod and a Cystidean have been disinterred from the "primordial zone" (the Lingula flags); but these are of genera familiar to us in the true Lower Silurian rocks. Annelida, and perhaps Trilobites, recede further back than the base of the Silurian; but, as yet, the Cambrian has yielded no other new and unexpected types, and, save a doubtful Zoophyte or Polyzoon, no other forms at all. And if we turn to the highest of the palæozoic groups, the reptiles which have at length been discovered in the Coal are found to belong to the lower forms with which we have become acquainted in the Permian and Trias; or, where they differ from these, it is to present indications of even a still lower grade*. It is impossible to help surmising, however unphilosophical it may appear to some, that we may not be very far from the downward limit of one at least of the zoological subkingdoms. If, indeed, we discovered a Brachyurous crab, or a single reptile of high organization in Silurian rocks,—a mammal in the Old Red, or a fish in the primordial zone, such a fact would go far to demolish the supposition. But the gradual tracing back of types a little only beyond their previous limits does not appear calcu-

* Owen, in 'Siluria,' 2nd edition, p. 363.

lated to shake the generally received opinion of a progressive organization of animals during geological time, the lower preceding the higher.

But can the same be said for plants? Coniferæ are among the most rife in the earliest strata in which land plants abound, and these are reckoned, by some of our best botanists, the highest types of plants! Dicotyledons succeed; and Monocotyledons, the least complex of the flowering plants, scarcely appear till Tertiary times. Has there been an inverse order of creation for plants, compared with that of animals? Is it true that Palms and Bananas are inferior to the Cypress and the Fir-tree?

V.—*Notes on the Hydroid Zoophytes.* By Prof. Allman.

I. *Tubularia indivisa.*

The reproductive sacs of *Tubularia indivisa*, though never destined to become free, and belonging to the type of *sporosacs* rather than *Medusæ*, present nevertheless a structure in which a true medusoid type may be fully recognized, and are thus of especial interest in establishing the exact relation between *sporosacs* and *Medusæ*, the two forms of bodies in one or other of which the generative elements of the marine Hydroid Zoophytes always originate.

Included within an external investment, or *ectotheque*, in which thread-cells are imbedded, is a second sac, having a well-defined opening near its summit. A circular canal, rendered evident by the red pigment-granules it contains, surrounds this opening. Four longitudinal canals open symmetrically into the circular canal, and thence, running along the inner side of the walls of the sac, enter the base of a large manubrium*, which extends through the axis of the sac.

Between the endoderm and ectoderm of the manubrium the generative elements (ova or spermatozoa) are developed, and when sufficiently mature escape, after the rupture or absorption of the confining ectoderm, through the opening in the sac just described, the ectotheque giving way before them, apparently by rupture.

It is impossible not to see here, in the sac which lies immediately within the ectotheque, the umbrella of a Medusa, with its orifice and its circular and radiating canals; so that in this highly interesting form of sporosac we have, with a closed manubrium, all the parts amply represented which are found in

* The diverticulum from the cœnosarc which extends through the axis of the sporosac, or forms the so-called peduncle of the Medusa.

the free Medusa, except the marginal tentacles, ocelliform bodies, lithocysts, and velum (?).

In the female sporosac, the generative product originates as a voluminous plasma, between the endoderm and ectoderm of the manubrium. It is evidently in more intimate relation with the endoderm than with the ectoderm, and as it increases in bulk it would seem to cause the absorption of the latter membrane, which confined it in its young state. A portion of it now becomes detached from the mass, and soon undergoes a special development into an embryo within the cavity of the sporosac. We must undoubtedly look upon this detached portion as an ovum, though I have never succeeded in demonstrating the presence of a germinal vesicle. The phænomenon of yelk-cleavage is also very obscure, but the entire ovum may be easily broken up into cells filled with secondary cells.

The ovum lies in contact with the remainder of the plasma, and while in this position becomes developed into an actiniform embryo, as has been pointed out by Van Beneden and others. In the act of development it becomes first extended as a disk over the residual plasma. Next, from the circumference of the disk, short and thick processes radiate all round, which soon elongate themselves into tentacula. The disk at the same time gradually becomes more gibbous on the side turned away from the axis of the sporosac; its interior becomes hollowed out into a stomach; and a mouth makes its appearance in the centre of the opposite side, or that in contact with the plasma. The embryo now retreats from the plasma, the mouth is seen to be elevated on a conical prominence, and a second circle of tentacula soon makes its appearance immediately around it. In this state it escapes from the sporosac, and after continuing free for a period it ultimately developes, from the side opposite to the mouth, a cylindrical stem, which soon clothes itself with a polypary, and fixes the young Tubularia to some neighbouring object.

While embracing the residual plasma in the sporosac, we are strongly reminded of the relation which subsists between the embryo and food-yelk, in those animals in which the embryo is developed from only a portion of the yelk. The analogy, however, is not so close as it may at first appear; and there is no evidence that the residual plasma is absorbed by the embryo during its development.

After the escape of the embryo, or even during its development within the sporosac, the remains of the plasma may still throw off portions which become developed in a similar way into free embryos.

In the male sporosacs, the spermatogenous tissue is manifestly composed of very delicate tubules, which are attached by one ex-

tremity to the endoderm of the manubrium, and thence radiating in all directions, fill the interspace between the endoderm and ectoderm with a dense tissue, in whose component tubules the spermatozoa, with their generating cells, are formed.

II. *Podocoryne carnea.*

I recently obtained, upon stones in rock-pools near low-water mark, and on old shells brought up upon the lines of the fishermen, a zoophyte which appears to be identical with a species described by Sars under the name of *Podocoryna albida,*—an animal, however, which seems to be only a variety of the zoophyte described by the same author under the name of *P. carnea.* It consists of a colony of colourless claviform polypes springing from a common tubular basis, which invests the surface of the stone or shell. The polypes are of two kinds, of which one rises to the height of about $\frac{1}{4}$ inch above the common basis. Its extremity is club-shaped, and bears a terminal mouth, behind which is situated a series of about twelve filiform tentacula, arranged in a single verticil. The polypes of this kind never bear gonophores ("generative vesicles").

The other kind of polypes spring, in common with those just described, from the tubular base. They are scarcely half the size of the former, and have only four or five tentacula, which are situated, as in the larger polypes, behind a terminal mouth, while, at a short distance behind the tentacula, there is always borne a verticil of medusiferous gonophores, generally four or five in number, each supported on a short peduncle.

Sars, in his description of *P. carnea,* states that the polypes are connected to one another by "a kind of foot or mantle, which forms upon the shells a thin membranous investment, and which appears to consist of numerous stolons anastomosing with one another;" but he makes no mention in this description of a chitinous polypary.

He tells us, however, a little further on, that, "after the death of the polype, the mantle remains behind as a brown epidermal investment, bearing numerous pointed spines of a horny nature, and which we may probably consider as a kind of polypary." He has met with this investment upon shells from different seas.

This latter part of his description is not consistent with the former; and it seems probable that he has confounded the solid muricated and chitinous basis of *Hydractinia* with the tubular basis of the present genus.

Sars describes his zoophyte as naked; but I believe this is not admissible as a character in any of the known marine Hydroid zoophytes, unless it be in *Hydractinia,* in which the solid chi-

tinous polypary is covered *externally* by the cœnosarc, thus reminding us of the sclerobasic corallum of some of the Actinozoa.

In the present species the common basis of the colony consists of an irregular network of chitinous tubes pervaded by the cœnosarc, and closely adherent to the surface of some fixed object. I had long ago satisfied myself of the presence of a basal tubular polypary in *Clava*; but, though I had carefully figured it with a view to publication, I delayed making it known, and in the meantime the same fact had been fully observed and recorded by Dr. S. Wright.

The medusa of *Podocoryne albida* has a deep umbrella with eight marginal tentacles, of which four are longer and continuous with the four radiating canals, and four shorter and alternate with them. Each tentacle springs from a bulbous base containing red pigment-granules. There is also a wide velum. The manubrium is of moderate length; and its oral end is divided into four lobes, each of which is terminated by a cluster of thread-cells, which are peculiar in the fact of every thread-cell being borne on the summit of a delicate thread-like peduncle. The entire cluster may be seen in a constant state of vibration,—a phænomenon, however, which is probably due merely to the action of currents excited in the surrounding water by cilia situated within the mouth.

It is apparently the present zoophyte, or at least a nearly allied species, which has been described by Mr. Peach in a former volume of this Journal.

III. *Manicella fusca*, nov. gen. et sp.

There occurs in the Firth of Forth, attached to other zoophytes and to sea-weeds near low-water spring tides, a Tubularian zoophyte with characters so peculiar as to entitle it to a distinct generic rank.

It is much branched, rising usually to the height of about ½ an inch, and having its ultimate ramuli disposed with a regularly pinnate arrangement.

The tentacles are about 16 in number, arranged in a single but slightly alternating series upon the club-shaped body, just behind an anterior conical projection which bears the mouth on its apex.

The polypary, which is of a dull brown colour, and opaque from the accumulation in it of minute particles of earthy matter and siliceous sand, presents the remarkable character of not being confined to the cœnosarc, but being continued over the body of the polype, and even for a considerable distance over the tentacles themselves; so that the only part of the zoophyte which

is naked is a small portion of the body just behind the mouth, and the terminal portion of the tentacles, which, when these are in the extended state, comprises a space of somewhat less than two-thirds of their entire length,—a character of true generic value. At the origin of the polypiferous ramuli, the polypary is marked by distinct spiral corrugations.

The gonophores belong to the class which contain sporosacs, and not Medusæ. They are borne each upon the summit of a short lateral branch, three or four of which are situated alternately along the entire length of the ultimate ramuli, and have their investing polypary marked by spiral corrugations. The polypary is continued over the entire gonophore. Each gonophore contains a single sporosac with a ramified spadix*.

I have not been able to find any description of the present animal, though Dr. S. Wright informed me last year that he had met with a Tubularian zoophyte in which the greater part of the polype was covered by the polypary. If it really prove to be an undescribed form, I would propose for it the name of *Manicella*† *fusca*, which is sufficiently expressive of some of its more striking characters.

IV. *Eudendrium bacciferum*, nov. sp.

Growing upon the basalt of some of the small rocky islands of the Firth of Forth, or attached to other zoophytes or to sea-weeds, there may be found near low-water mark a small Tubularian zoophyte, which also presents a form which may prove of generic value, but at all events is one of well-marked specific distinctness from any with which I am acquainted.

It attains a height of about an inch. It is much and irregularly branched, though the ultimate or polypiferous ramuli present for the most part a pinnate arrangement. The main stem is thickest near the root, and is here distinctly composed of aggregated tubes. It becomes gradually attenuated as it gives off its branches, and finally, like the branches, consists of a simple tube.

The ultimate ramuli are for the most part abruptly bent to one side, a little behind their terminal polypes,—a character which gives a special and rather peculiar aspect to the zoophyte.

The polypary is slightly corrugated on the branches, without being anywhere distinctly annulated, and is continued over the

* The endodermal portion of the manubrium, from which the generative elements directly originate.

† A diminutive noun, from *manica*, the long Roman sleeve which performed the office of a glove; the allusion is to the extension of the polypary over the body and tentacles of the polype.

posterior part of the body of the polype in the form of a funnel-shaped cup, which does not, however, extend as far as the origin of the tentacles, and which, though it reminds us of the polype-cell in the Campanularian zoophytes, is incapable of receiving the tentacles and anterior part of the polype even in extreme retraction.

The tentacula are seated near the middle of the club-shaped body. They are about ten in number, and are arranged in a single verticil. Their cavity presents the septate appearance usual in the marine polypes; but under slight pressure the contents of the stomach are easily forced into them without any evident rupture of the tissues.

The body in front of the tentacles is continued into a long, conical, but mutable, mouth-bearing process.

The gonophores are remarkably large, and are chiefly formed upon the main stem and primary branches. They are of an oval figure, each borne on a long peduncle which issues from the summit of a very short lateral ramulus, invested like the other branches with a proper polypary, which is here, exactly as in the polypiferous ramuli, dilated at its summit so as to form a conical cup, from whose centre the peduncle of the gonophore springs.

The contents of the gonophores in this species are sporosacs; and in the structure of these there are some points which deserve attention. Lining the inner surface of the ectotheque, and interposed between it and the endotheque or sac which immediately confines the generative elements, is a third investment, which is plainly homologous with the umbrella of a Medusa. It supports upon its inner side four (or more?) short radiating canals, which spring from the base of the manubrium, and, after running forwards for a short distance, terminate each in a blind extremity. There is no trace of a circular canal.

We have thus, in the present zoophyte, a form of sporosac intermediate between that met with in *Tubularia*, with its well-developed umbrella and radiating and circular canals, and that which occurs in the greater number of cases where the umbrella has entirely disappeared.

When the gonophores approach maturity, they present upon their summit a well-defined prominent opening destined to give exit to the ova or spermatozoa.

The ova possess a deep-orange vitellus, but otherwise present nothing peculiar. They have a distinct germinal vesicle and germinal spot, and, as in most of the Hydroid zoophytes, become transformed into a Leucophrydiform embryo.

The spermatogenous tissue of the male sporosac presents very distinctly the appearance of radiating striæ, indicating a com-

position out of tubules. The spermatozoa have a long conical body with a caudal filament.

The cœnosarc of *Eudendrium bacciferum* is of an orange colour, which being visible through the transparent polypary, especially in the younger portions of the specimen, renders the zoophyte, notwithstanding its small size, eminently conspicuous among its more sombre associates, particularly when furnished with its large berry-like deep-orange gonophores.

The general character of the present zoophyte, but especially the very remarkable position of the gonophores on the summit of true, though arrested branches, affords a strong inducement to define it as a new genus; and as such I had recorded it in my note-book. I believe, however, the adoption of this course would be premature in the absence of further information regarding allied forms, which can be surely determined only when examined in their living state and while furnished with their polypes and gonophores; and I therefore consider it safer to view it for the present as a *Eudendrium*, though a very distinct species. If the result of a critical study of the various species of *Eudendrium* and its allied genera should prove the title of this zoophyte to a distinct generic rank, I would propose for it the generic name of *Corythamnium*.

V. *Coryne Briareus*, nov. sp.

The *Coryne* which forms the subject of the present note was found covering the surface of a stone in one of the rock-pools left upon the shore of the Forth by the retiring tide.

An irregular network of chitinous tubes adhered to the surface of the stone, and threw up at close intervals, to the height of about half an inch, wider tubes, from whose summits the polypes emerged. These polypiferous tubes themselves frequently gave off long free branches, which then bore short polypiferous ramuli, like those which spring immediately from the adherent net-like stolon.

The polypes are of a clear white, with an occasional pinkish tint given by the coloured granules of the stomach-walls. They are very extensile, and in their fully-extended state they assume nearly a cylindrical shape, their club-like form becoming almost entirely obliterated. The tentacles are very numerous, from forty to fifty, and are scattered irregularly over the body, or at most show a very slight tendency, when the polype is fully extended, to a verticillate arrangement.

The gonophores are borne in a single, somewhat verticillate cluster upon the body of the polype, having a few tentacles behind them, but the greater number in front of them. They are supported upon short peduncles, and contain each a single

Medusa, conspicuous through the walls of the gonophore by the fine carmine-coloured bands by which the inner surface of the stomach is marked.

When the Medusa escapes from the gonophore, it is seen to present a structure which is very peculiar. The umbrella is of a nearly spherical form, with two marginal tentacles continuous with two opposite radiating canals. A small bulbous dilatation is situated at the intersection of each of the other two marginal canals with the circular canal, but no tentacle is here developed. There is a wide velum. The manubrium is well developed, of a nearly cylindrical shape; and the mouth is not furnished with lobes or tentacles.

The structure of the two marginal tentacles is very remarkable. Each commences with a wide bulbous dilatation containing reddish pigment-granules, and is then, for the remainder of its length, closely set along its external side with pedunculated oval sacs filled with thread-cells.

Another striking peculiarity in the Medusa consists in a cæcal tube which is given off from each of the tentacular bulbs, and then running in the substance of the umbrella, close upon its outer surface and exactly parallel with the corresponding radiating canal, becomes slightly dilated as it proceeds, and terminates, after a short course, in a blind extremity. An exactly similar tube is given off from each of the two intermediate bulbs. The contents of these cæca are a clear fluid with thread-cells.

I propose for the *Coryne* here described the specific name of *Briareus*.

VI.—*Descriptions of new Genera and Species of Phytophagous Insects.* By J. S. Baly, Esq.

Fam. Chrysomelidæ.

Genus Doryphora, Illig.

Doryphora dilaticollis (Dej.).

D. oblonga, convexa, nitido-viridi-ænea, cæruleo-micans; thorace utrinque foveolato, subremote punctato, utroque latere in laminam obliquam subacutam producto; elytris subcrebre punctatis, punctis obsolete subseriatim dispositis, interstitiis aciculato-reticulatis.

(*Fœm.*) Thoracis lateribus non dilatatis, rotundatis, antice angustatis.—Long. 8 lin.

Hab. Brazil.

Doryphora cærulea.

D. oblonga, convexa, nitido-cærulea; thorace remote punctato, ely-

tris paullo latiore, lateribus dilatatis, rotundatis; elytris subseriatim punctatis, remote reticulato-aciculatis.

(*Fœm.*) Thorace elytris angustiori, lateribus rotundatis.—Long. 6½–7½ lin.

Hab. Ega, Upper Amazons.

Differing from *D. sappharina*, Forst., to which insect it is most nearly allied, by its much broader thorax: in the latter insect the thorax is considerably narrower than the elytra, the sides at the same time being straight, and rounded at their apex only.

Doryphora cardinalis.

D. late ovata, valde convexa, obscure æenea, corpore subtus antennisque nigro-æneis, his extrorsum nigris; capite subremote tenuiter punctato, inter oculos unifoveolato; labri margine flavo; thorace longitudine triplo latiore, disco utrinque foveolato, remote tenuiter, lateribus subremote subfortiter punctato; elytris subseriatim punctatis, rufo-fulvis, sutura et margine laterali anguste, fasciisque tribus e maculis oblongis, æneis, harum prima ante, secunda prope, tertiaque obliqua pone medium positis.—Long. 8–8½ lin.

Hab. Venezuela.

Doryphora congener.

D. ovata, convexa, pallide viridis, antennis extrorsum nigris; femoribus spinaque obscure flavis; thorace longitudine plus duplo latiore, subremote tenuiter punctato; elytris tenuiter seriatim punctatis, punctis in striis confuse gemellato-dispositis, striis disco exteriori confusis.—Long. 5½ lin.

Hab. Venezuela.

Doryphora Jekelii.

D. ovate convexa, nitido-cuprea, subtus obscurior; capite thoraceque punctis distinctis sparse hic illic impressis; elytris remote tenuiter punctatis, irregulariter strigosis, utrisque seriebus 10 (prima abbreviata) e punctis distantibus majoribus impressis.—Long. 6 lin.

Hab. Columbia.

Doryphora lurida.

D. late oblonga, convexa, nitido-nigro-ænea; thorace elytrorum latitudine, punctis magnis sparse hic illic fortiter impresso, punctis ad latera subvariolosis; elytris rufo-fulvis, punctis magnis nigro-æneis irregulariter, prope suturam subseriatim, impressis, utrisque fasciis tribus nigro-æneis, prima ante, secunda vix pone, tertiaque pone medium positis, illa transversa extrorsum, his obliquis, minus distinctis, utrinque abbreviatis.—Long. 8–9 lin.

Hab. Napo.

Doryphora amabilis.

D. oblongo-ovata, convexa, nitido-fulva, antennarum apice fusco;

capite thoraceque irregulariter punctatis, utrisque maculis quatuor (in hoc transversim positis), elytrisque fusco-æneis, his subseriatim punctatis, limbo fulvo.—Long. 4 lin.

Hab. Amazons.

Doryphora miniata.

D. breviter ovata, convexa, obscure rufo-fulva; elytris striato-, disco exteriori irregulariter-punctatis, fusco-æneis, vitta submarginali, vitta subsuturali postice, primæ apice confluente, puncto subbasali prope suturam, fasciaque brevi centrali, fulvis; femoribus obsolete fusco-æneo-maculatis.—Long. 5 lin.

Hab. Peru.

Doryphora Stälii.

Doryphora Bohemanni, Baly, Trans. Ent. Soc. Lond. vol. iv. n. s. p. 344, 1858, *nec* Stäl.

Doryphora pluviata.

Doryphora irrorata, Baly, Trans. Ent. Soc. Lond. vol. iv. n. s. p. 346, 1858, *nec* Stäl.

The names of the two preceding insects having been used by Herr Stäl in his recent paper on *Doryphora*, published at Stockholm in the same year, but several months previous to mine, I am compelled to change them.

Doryphora Fryella, Baly.

Doryphora flavocincta, Baly, Trans. Ent. Soc. Lond. vol. iv. n. s. p. 347, *nec* Guérin.

It also becomes necessary to alter the name of this species, it having been made use of by Guérin in 1855.

Genus Cryptostetha, Baly.

Cryptostetha suturalis.

C. oblongo-ovata, convexa, dorso prope medium obsolete gibbosa, obscure ænea; thorace subopaco, lateribus rotundato, dorso sparse hic illic fortiter punctato; elytris fortiter punctatis, punctis ad latera irregulariter confluentibus, interstitiis elevatis, fulvis, sutura (hac basi dilatata), margine laterali maculisque obscure æneis.—Long. 6 lin.

Hab. Brazil.

Differently coloured, and the elytra more coarsely and deeply punctured than *Cryptostetha marmorata*; also more convex.

Cryptostetha ænea.

C. oblongo-ovata, convexa, dorso prope medium obsolete gibbosa, viridi- aut cæruleo-ænea, nitida, puncto frontali fulvo; thorace subopaco, remote tenuissime punctato, basi margineque laterali

rotundato, magis distincte punctatis; elytris subcrebre fortiter punctatis, punctis aciculatis, interstitiis elevatis.—Long. 5½–6½ lin.

Hab. Brazil.

Cryptostetha rufipennis.

C. ovata, convexa, nigra, nitida, puncto frontali elytrisque testaceis, his tenuiter subseriatim punctatis, punctis ad latera confusis, interstitiis obsolete strigosis; thorace longitudine duplo latiore, remote tenuiter punctato, lateribus fere rectis, antice angustato-rotundatis. —Long. 6 lin.

Hab. Brazil.

Genus Elytrosphæra, Blanch.

Elytrosphæra flavipennis, Dej. MSS.

E. oblonga, convexa, nitido-purpurea; thorace fortiter et irregulariter punctato, punctis (præsertim ad latera) varioloso-confluentibus; elytris ovatis, valde convexis, fulvis, utrisque sulcis 11, primo abbreviato, horum singulis serie unica punctorum magnorum impressis, interstitiis elevatis, convexis; abdomine subcrebre punctato, segmento anali fulvo.—Long. 6–6½ lin.

Hab. Brazil.

This common insect, although well known by collectors under the above name, has not as yet been described.

Elytrosphæra Dejeanii.

E. oblongo-ovata, convexa, obscure metallico-viridis, nitida, abdominis segmento anali elytrisque fulvis, his ovatis, convexis, utrisque seriebus 11 e punctis magnis subremotis impressis, prima abbreviata; thorace hic illic fortiter punctato.—Long. 5 lin.

Hab. Brazil.

Elytrosphæra confusa.

E. oblonga, convexa, obscure nigro-æenea, nitida; elytris rufo-fulvis, ovatis, valde convexis, subseriatim, disco confuse punctato-sulcatis, punctis fortiter impressis, æneo-micantibus, interstitiis elevatis, subtuberculatis; thorace longitudine vix dimidio latiore, fortiter punctato, punctis irregulariter confluentibus.—Long. 5–6 lin.

Hab. Brazil.

Elytrosphæra luridipennis.

E. oblonga, convexa, nigro-æenea, nitida; thorace longitudine fere duplo latiore, lateribus hic illic sparse confluento-punctatis; elytris obscure rufis, oblongo-ovatis, convexis, fortiter subseriatim, apicem versus confuse, punctatis, interstitiis subelevatis.—Long. 6 lin.

Hab. Brazil.

Genus Stilodes, Chevr. MSS.

Caput subdeclive, thoraci ad oculorum marginem insertum; ***antennis*** capite cum thorace vix longioribus, modice robustis, subfili-

formibus, ad apicem leniter compressis et incrassatis, articulo primo incrassato, secundo brevi, tertio elongato, cæteris inter se æqualibus, perparum leniter incrassatis; *palpis maxillaribus* leniter compressis, clavatis, articulo penultimo obconico, ultimo vix latiore, hoc brevi, transverso, apice truncato. *Thorax* transversus, apice late emarginatus. *Elytra* breviter ovata aut obovata, convexa, thorace latiora, postice sæpe paullo angustata. *Pedes* simplices. *Mesosternum* transversum, obliquum. *Corpus* ovatum, convexum.

Type, *Stilodes guttata*, Baly.

Nearly allied in form to *Chrysomela*, but easily separated from that genus by the different form of the maxillary palpi together with the shorter antennæ.

Stilodes guttata.

S. ovata, convexa, rufo-fulva, nitida, oculis mandibularumque apice nigris; thorace longitudine fere triplo latiore, evidenter remote punctato, punctis ad latera majoribus, valde impressis; elytris breviter ovatis, postice vix angustatis, convexis, utrisque lineis 11 e punctis impressis, harum prima abbreviata; maculis 8 fulvis instructis, duabus basalibus, duabus ante medium oblique, duabus pone medium transversim, duabusque apicem versus longitudinaliter, positis.—Long. 4 lin.

Hab. Upper Amazons.

Stilodes obsoleta.

S. ovata, convexa, postice paullo angustata, nitido-rufo-fulva, antennis extrorsum nigris; thorace longitudine plus duplo latiore, remote tenuiter, lateribus magis distincte punctato; elytris seriatim punctatis, utrisque maculis septem obsolete fulvis, duabus baseos, duabus ante, duabus pone medium et una ante apicem, positis.—Long. 4 lin.

Hab. Ega, Upper Amazons.

Narrower than the preceding species.

Stilodes fenestrata.

S. ovata, convexa, fulva, nitida; thorace subremote punctato, nigro, lateribus fulvis; elytris breviter ovatis, postice paullo angustatis, convexis, utrisque lineis 11 e punctis leniter impressis, harum prima abbreviata, punctis in striis confuse dispositis; plagis magnis tribus superficiem fere amplectentibus, nigris, prima transversa basi, secunda late transversa supra medium, tertiaque trigona apicem versus, positis, pleuris remote punctatis, nigris.—Long. 4 lin.

Hab. San Paulo, Upper Amazons.

Stilodes annuligera (Erichs.).

Deuterocampta annuligera, Erichs. Consp. Ins. Peru. p. 157, 1847.

S. ovata, convexa, postice paullo angustata, fulvo-rufa, nitida; thorace

disco subremote tenuiter, lateribus subvariolo-punctato; elytris seriatim punctatis, obscurioribus, utrisque annulis duobus magnis linea longitudinali prope suturam connexis, prima basi, altera vix ante apicem positis, fulvis.—Long. $3\frac{1}{2}$ lin.

Hab. Amazons.

Stilodes quadriguttata.

S. ovata, convexa, nitido-nigro-cyanea, antennarum basi fulva; thorace tenuiter punctato; elytris purpureis, regulariter seriatim punctatis, utrisque maculis duabus, prima baseos obliqua, altera ante apicem transversa, ad marginem exteriorem adfixa, fulvis.—Long. 4 lin.

Hab. Amazons.

Stilodes scenica.

S. breviter ovata, convexa, obscure rufa; thorace æneo obsolete micante, disco remote tenuiter, lateribus subcrebre magis distincte, punctato; elytris flavis, utrisque lineis 11 e punctis (harum prima abbreviata) instructis; sutura, vitta marginali antica maculisque oblongis tribus vix infra basin ad paullo ultra medium triangulariter dispositis, obscure æneis.—Long. $4\frac{1}{2}$ lin.

Hab. Brazil.

Stilodes histrio.

S. ovata, convexa, postice vix angustata, rufo-fulva, nitida; antennis extrorsum nigris; abdominis segmentorum margine, pleuris, tibiarum apice, et capitis thoracisque maculis, obscure æneis; elytris regulariter seriatim punctatis, flavis, sutura antice, maculis duabus baseos vittulisque obscure æneis (vittulis interstitiis alternis dispositis, fascias transversas duas formantibus); thorace basi lateribusque distincte punctato, maculis æneis inter se confluentibus seriebus duabus transversis dispositis.—Long. $4\frac{1}{2}$ lin.

Hab. Brazil.

Stilodes cruciata.

S. ovata, convexa, nigro-ænea, nitida; antennis nigris, basi piceis; thorace longitudine plus duplo latiore, subremote punctato; elytris seriatim, disco exteriore confuse, punctatis, nitido-luteis, vitta suturali apice dilatata fasciaque transversa prope medium nigris. —Long. $3\frac{1}{4}$ lin.

Hab. Columbia.

Genus Lina, Megerle.

Lina Templetoni.

L. breviter ovata, postice paullo ampliata, valde convexa, nitido-cyanea, abdomine, pedibus capiteque æneo-micantibus, antennis nigris; thorace longitudine vix duplo latiore, utrinque foveolato, disco obsolete, angulis posticis varioloso-punctato, lateribus subincrassatis, postice sinuatis, antice ampliato-rotundatis; elytris rufo-testaceis, thorace multo latioribus, valde inflatis, lævibus,

lateribus infra humeros leniter transversim excavatis.—Long. 5½ lin.

Hab. Ceylon.

Closely allied to *Lina Rayah,* but easily distinguished from that insect by its smaller size and perfectly smooth elytra. My specimen has the elytra stained with numerous small rufo-piceous points irregularly arranged in longitudinal striæ; I think these are only due to immersion of the insect in spirit.

Lina æneipennis.

L. ovata, postice paullo ampliata, convexa, nitido-testaceo-fulva, antennis extrorsum nigris; thorace longitudine duplo latiore, convexo, obsolete foveolato, tenuiter punctato, lateribus a basi ad apicem angustato-rotundatis; elytris viridi-æneis, subcrebre punctatis, punctis prope suturam obsolete subseriatim dispositis.—Long. 4½ lin.

Hab. Northern China.

Genus Gastrolina.

Caput thoraci ad oculos insertum; *oculis* ovato-rotundatis; *antennis* corporis dimidio brevioribus, subfiliformibus, ad apicem leniter incrassatis, articulo primo obovato, incrassato, secundo brevi, cæteris oblongo-obovatis, tertio elongato, ultimo ovato; *palpis maxillaribus* subfiliformibus, articulo ultimo ovato. *Thorax* transversus. *Scutellum* subtriangulare. *Elytra* thorace latiora, oblongo-ovata, dorso complanata. *Pedes* simplices, *unguibus* apice subtus bidentatis. *Abdomen* fœminæ gravidæ valde distendum, ultra marginem elytrorum extensum. *Corpus* oblongum, depressum.

Type, *Gastrolina depressa,* Baly.

Separated from *Lina* by its depressed form, and by the distended abdomen of the pregnant female.

Gastrolina depressa.

G. **oblonga, depressa, nitido-nigra, æneo-micans; abdominis lateribus thoraceque flavo-fulvis, hoc longitudine plus duplo latiore, disco irregulariter impresso, tenuiter punctato, utrinque intra marginem longitudinaliter foveolato et crebre punctato, margine ipso subincrassato, postice subrecto, antice leniter ampliato rotundato; elytris dorso complanatis, crebre confuse, prope suturam subseriatim, punctatis, utrisque sutura vittisque tribus subelevatis, obscure cyaneis, margine incrassato nigro-æneo.—Long. 3½ lin.**

Hab. Northern China.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

The Instructive Picture Book; or, a few attractive Lessons from the Natural History of Animals. By ADAM WHITE, Assistant Zoological Department, British Museum, &c. &c. Third Edition, with many Illustrations by J. B. and others. Edinburgh: Edmonston and Douglas, 1859.

THIS is no ordinary picture-book; it is really and truly what it professes to be—an *Instructive* Picture-book. Look, for instance, at plate 11, at the *picture* of the Giraffe by J. B. The various attitudes of the creatures there represented are exceedingly well done—life-like—almost *Wolf*-like, if we may use the expression. Then turn to p. 26 of the letter-press, and read the description of the "noble creature with its finely waved neck, and its curious head with the large languishing eye and dark eyelids." The Brown Rat, too (plate 7), is good, and the descriptive letter-press at p. 20 is full of interesting information. Gloves, the author tells us, are made of rats' skins; and we can, from personal knowledge, vouch for their fine, soft texture and quality. The manufacture, we believe, is chiefly in Paris, where rats are more abundant than they are in London. In plate 12 we have the little Alderney Cow, and the intelligent and inquisitive-looking West Highland Bull; he is a good sample of the ruminating animals; and Mr. White's description of him, of the little Alderney, and the *Cow* in general, indeed, at p. 26, is well worthy of a perusal. Many little bits of valuable information may be derived from reading the descriptive letter-press, which we would strongly advise the young, for whose use this book is so carefully got up, not to skip over. Thus, in the description of plate 13, under the heading "Fallow Deer," p. 28, we read the following fact, which all may not be acquainted with, and the explanation of it:—"When Deer drink, they can plunge their heads into water almost up to the eyes; for, besides the nostrils, they have two breathing-places, one at the corner of each eye, which they can open at will: when they are hard run, these spiracles, as they are called, assist them much in breathing." We may perhaps prefer the illustrations of the Quadrupeds in this book to those of the Birds. Plate 17, however, the *picture* of the Parrot race, is very striking; and Mr. White, at p. 33, is very happy in his description of the species represented. So is he also at p. 43, in describing the common Cock and Hen. Plate 25 and the Frontispiece, representing Sea-birds, are plates which will be sure to please the young; while the author's description of them at p. 49, with his recollections of the animated scenes of the Bass Rock and the Shetland Isles, cannot fail to arrest their attention and fix them upon these interesting animals.

Mr. White's style of writing is very pleasing, and exceedingly well adapted for young people. There are no tiresome descriptions of animals; but the minds of his juvenile readers are led as it were imperceptibly to a knowledge of the creatures figured in the plates, and thus to take an interest in them. We would recommend him, however, to avoid *puns*; for although his manner of conveying in-

formation is playful and jocose, such as a child would like to read, his puns are not good; nor are they such as his model, the late Charles Lamb, would care to have attached to his name. Speaking, for instance, of the Kangaroo, Mr. White says that the flying leaps of the great Boomer Kangaroo were found to measure 15 feet, "each hop being as regular as if the ground had been stepped over by a drill-sergeant. Charles Lamb," he adds, "would have called him a hopeful subject"! His language, too, in some places, is rather ambiguous. The notice of the Green Lizard, for instance, is very interesting—"a harmless and very pretty creature, which delights to bask in the sun, as if it wanted its cold blood warmed with the genial rays;" but we never knew before that this pretty little reptile could either admire, with a painter's eye, a beautiful landscape, or, like a skilful botanist or entomologist, collect plants or insects!—and yet our author says, "Jersey abounds in lizards; for I saw them nearly everywhere as I rested, *admiring the views, or picking up wild flowers and insects.*" Of course it was the author who did so; but, from the allocation of the words, and the punctuation, it appears as if it were the lizard that admired the prospect and picked up the wild plants.

In his preface, Mr. White gives us to understand that this volume is to be followed by another, containing "some of the more striking objects of Zoology." We shall be glad to see him again. From the title-page, it appears that this is the third edition of this work. It deserves such encouragement; for it is carefully got up, the descriptive letter-press contains much valuable information, which even *adults* may enjoy and be improved by, and the illustrations, which are generally upon a large scale, are sure to please the young, and give a good idea of the most striking characteristics of quadrupeds and the gay plumage of birds. At the end of the book there is appended a scientific index and a kind of tabular arrangement of great part of the animal kingdom. These must be very useful both to the general reader and to the teacher or parent who may use the book. To them and to all concerned in the education of young people, we strongly recommend this "Instructive Picture Book."

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

December 16, 1858.—Sir Benjamin C. Brodie, Bart., President, in the Chair.

"Description of a mutilated skull of a large Marsupial Carnivore (*Thylacoleo Carnifex*, Ow.), from a conglomerate stratum, eighty miles S.W. of Melbourne, Australia." By Professor R. Owen, F.R.S., &c.

In this paper the author gives a description of a fossil skull and certain of the teeth of a quadruped of the size of a lion, in which he

points out the characters indicative of its carnivorous habits and of its affinities to the marsupial order.

The large size of the temporal fossæ, meeting to form a low crest on the parietal bone, and bounded behind by a strong occipital crest; together with large carnassial teeth in both upper and lower jaws, evince the carnivorous habits of the extinct species. Its marsupial nature is, in the author's opinion, demonstrated by the following cranial structures:—A large vacuity in the bony palate; a proportionally large lacrymal bone extending upon the face and perforated by the lacrymal canal, anterior and external to the orbit; three external precondyloid foramina; the perforation of the basisphenoid by the entocarotid canal; the great interval between the foramen ovale and foramen rotundum; the separation of the tympanic from the petrous bone; and the development of the 'bulla auditoria' in the alisphenoid; the position of the outlet for a vein from the lateral sinus behind and above the root of the zygoma; finally, the low and broad occiput, and the very small relative capacity of the brain-case.

In the marsupial order, the present large extinct Carnivore, for which the author proposes the name of '*Thylacoleo** *carnifex*,' is most nearly allied to the *Dasyurus* (*Sarcophilus*) *ursinus*; but is very different in its dentition from that and all existing Carnivora.

The fossils described were discovered by William Adency, Esq., in a calcareous conglomerate stratum in a bank of a lake situated 80 miles south-west of Melbourne, Australia.

January 13, 1859.—Sir Benjamin C. Brodie, Bart., President, in the Chair.

"On the Embryology of *Comatula rosacea* (Linck)." By Prof. Wyville Thomson.

The author briefly described the male and female reproductive organs of *Comatula*. When the ova are mature, and before impregnation, they are protruded and remain hanging from the ovarian orifice, entangled in the areolar tissue of the everted ovary. In this position impregnation appears usually to take place.

After segmentation of the yelk, a solid nucleus is formed in the centre of the mulberry yelk-mass. This nucleus becomes invested in a special membrane; and into this embryonic mass the remainder of the yelk is gradually absorbed. Ciliary motion is observed at various points on the surface of the enclosed embryo, which finally assumes its characteristic form. The young larva, on escaping from the egg, consists of a homogeneous mass of pale-yellow granular matter, with scattered nuclei, cells, and oil-globules. It is barrel-shaped, and girded at intervals with about five broad ciliated bands.

As development proceeds, one of these belts becomes depressed at a certain point; and within the loop thus formed, an inversion of the integument indicates the position of the rudimentary mouth.

A distinct œsophagus and stomach are rapidly differentiated, and a short intestine, ending in a large anal orifice, near the posterior

* From θύλακος, a pouch; λέων, a lion.

extremity of the animal. The larva at the same time becomes lengthened and vermiform; the girding ciliated bands resolve themselves into a single transverse band, encircling the body near the anterior extremity, and a band passing below the mouth and longitudinally down either side to the tail.

Large lobulated masses of fine granular tissue occupy the cavity of the body on either side of the alimentary canal.

The echinoderm-zooid originates, apparently, beneath the integument of the larva, but perhaps in an inversion of that integument, in the form of a rosette of cells encysted near the upper extremity of the intestine. The rosette is at first single, but shortly takes the appearance of a double ring, the rings being united by a curved tube. These rings seem to represent the rudiments of the ambulacral vascular system of the echinoderm, and the curved tube the origin of the alimentary canal. A dense coating of granular areolar tissue is formed round the young crinoid, obscuring the further development of the internal organs. The mode of its disengagement from the larva was not observed.

Free from the locomotive larva, the echinoderm in its earliest stage is a motionless, white, egg-like body, covered externally with a thick transparent layer, which is traversed vertically by scattered fusiform oil-cells.

Beneath this layer are seen rapidly-forming patches of the calcified areolar tissue so characteristic of the class. The body becomes club-shaped; the narrow end attaches itself by cement-matter to some foreign substance, and a head and stem are distinguished.

Two corresponding rows of five plates each (the *basalia*, and the first row of the *interradialia*) form a calcareous chalice round the base of the head. Rudimentary arms now first make their appearance, and the development of the attached pentacrinal form proceeds steadily.

From his observations of several broods during the spring of 1858, the author was led to believe that, under circumstances favourable to the production of the pentacrinal stage, the development of the larva may be arrested in any of its earlier stages, and before the complete differentiation of its internal organs. It is hoped that the observations of another season may solve this and other questions which still remain somewhat obscure.

February 3, 1859.—Sir Benjamin C. Brodie, Bart., President, in the Chair.

"On the Aquiferous and Oviductal Systems in the Lamellibranchiate Mollusks." By George Rolleston, M.D., Lee's Reader in Anatomy, and Charles Robertson, Esq., Curator of the Museum, Christ Church, Oxford.

In this paper the authors bring forward two views as to the anatomy of the Lamellibranchiata.

1. The first part of the communication is devoted to an examination of the commonly-received opinion as to the outlet of the ovarian

system, and arguments are brought forward to show that the orifices usually supposed to discharge this office are in reality the exhalant orifices of a water-vascular system. The positive arguments drawn from the way in which fine injections thrown in by these orifices distribute themselves throughout the visceral mass, and from the relative position of orifices acknowledged to belong to a water-vascular system in other mollusks, are confirmed by a consideration of the improbability attaching to the old view, which regarded as oviducts in mollusca two canals, which lying one on either side of the body, yet communicate freely with each other at no great distance from their termination, and which lie far away from the lower segment of the intestinal tube. The inhalant aquiferous orifices are considered to be indicated by a belt of parasitic animals impacted in the foot tissue, as represented in one of the figures.

2. In the second part of the communication, the structures are indicated which the authors hold to be the true oviducts. One large band which is seen at the spawning season as a prominent ridge projecting into the calibre of the lower segment of the intestinal tube, and two smaller ones, which are traceable from the commencement of the intestine down to a point where its upper coils are in close proximity to that part of its lower segment where the former band ends in a club-shaped dilatation, are shown to discharge this function. The method of dissection to be adopted for the demonstration of these structures is given at some length, and the following arguments are adduced in support of the view which regards them as oviducts. A fine injection thrown into the largest of the bands in question is seen to pass into the ovary, and is recognizable under the microscope as contained within the limitary membrane of its ultimate follicles. Its distribution, therefore, as detectable at once by the naked eye and by the microscope, contrasts strongly with that of a similar injection thrown in by either of the aquiferous orifices. *Secondly*: The condition of distension, prominence, and intumescence of this band, coincides with similar conditions in the ovary; and from an acquaintance with the condition of the branchial marsupium's contents we are enabled always to predict what will be found to be that of this band. *Thirdly*: At periods when ova are being rapidly secreted by the ovary, ova are to be found at all points within the whole length of these three bands. The double oviduct at the oral and the single at the anal extremity of the Lamellibranchiata, is what our knowledge of their development would lead us to anticipate; and the close connexion of the principal oviduct with that latter outlet, and with the lower segment of the intestinal tube, brings the anatomy of these bivalve mollusks into exact correspondence with that of higher tribes in the same series.

What is said of the ovarian secretion and outlets, applies, *mutatis mutandis*, to the testicular.

February 24, 1859.—Sir Benjamin C. Brodie, Bart., President, in the Chair.

"On the Different Types in the Microscopic Structure of the Skeleton of Osseous Fishes." By A. Kölliker, Professor of Anatomy and Physiology in the University of Würzburg.

After having been occupied for several months with observations on the minute structure of the bones of fishes, I now take the liberty to present the results of my studies to the Royal Society.

The principal fact which I have to mention is, *that a great many genera of osseous fishes possess no bone-corpuscles, radiated or fusiform, in their skeleton, and therefore no real osseous tissue.* That there exist fish-bones without bone-corpuscles must have been long known in England to those who have collections of microscopic preparations of the hard tissues of animals, as Owen, Tomes, Williamson, Quekett, and others; but nobody seems to have mentioned the fact before Williamson, Quekett, Dr. Mettenheimer of Frankfort, and myself*. In the year 1850 Professor Williamson pointed out the absence of bone-corpuscles from the bones of the Cod, Haddock, Perch, Plaice, Pike, and various other fish, distinguishing them in this respect from the bones of the Eel, in which such corpuscles are abundant†; in 1853 I made known‡ that the bones of *Leptocephalus* and *Helmichthys* contain no trace of bone-corpuscles; a year later, Mettenheimer showed that the same was true of the bones of *Tetragonurus Cuvieri*§; and in 1855 Quekett mentions, in the second volume of the 'Histological Catalogue of the College of Surgeons of England,' fishes belonging to eighteen genera, in the bones of which he had not succeeded in finding bone-corpuscles—viz. *Vogmarus islandicus, Lophius piscatorius, Gadus morrhua, Ephippus, Sparus, Trigla cuculus, Belone vulgaris, Pleuronectes platessa, Trachinus vipera, Orthagoriscus mola, Exocœtus, Scarus, Esox, Sphyræna barracuda, Tetrapturus, Zeus faber, Perca fluviatilis, Gobio fluviatilis.* But, notwithstanding these most valuable observations, little or no progress seems to have been made in the more general treatment of this matter, as is best shown by the 'Comparative Histology' of Leydig (1857), in which (p. 157) the *Leptocephalidæ, Tetragonurus*, and *Orthagoriscus* are the only cases mentioned, in which the radiated bone-corpuscles are wanting.

On commencing a series of more extended investigations into the minute structure of fish-bones, in October last, I found that the genera which possess real osseous tissue are rather scarce, whilst,

* Since this communication was read to the Society, Dr. Sharpey has directed my attention to a statement by the late Professor J. Müller, to the effect that in the Pike and many other fish the bones are destitute of bone-corpuscles. This statement occurs in Müller's Annual Report of the progress of Anatomical and Physiological Science in 1835, and is repeated in his addition to the work of Miescher, "De Inflammatione Ossium, eorumque Anatome Generali," Berlin, 1836, p. 269.

† Phil. Trans. 1851, p. 693.

‡ Zeitschr. f. wiss. Zool. iv. p. 361.

§ Anat.-histol. Untersuch. ü. d. *Tetragonurus Cuvieri*, in den Abh. d. Senkenberg. Gesellschaft, i. p. 241.

on the other hand, I fell in with a great many types in which the bones contained no trace of lacunæ. And as this fact not only appeared to me of interest with regard to the development of the bones of fishes, but also promised to become of great value in systematic zoology, and in the determination of fossil remains, I devoted my whole time to this question. Now that I have investigated more than 200 species belonging to nearly all tribes of osseous fishes, and mounted about 500 microscopic preparations of their hard structures, I hope to be able to treat this question more comprehensively than has been possible hitherto, and in such a way as to lead to some general conclusions.

In giving the results of my observations, I begin with an enumeration of the fishes which belong to the one, and those which belong to the other type.

I. *Fishes whose bones contain no bone-corpuscles.*

Ordo I. ACANTHOPTERI.

Fam. 1. *Percoidei.*

Perca fluviatilis.
Apogon Rex mullorum.
Pomatomus telescopium.
Lucioperca sandra.
Serranus cabrilla.
Anthias buphthalmus.
Acerina vulgaris.
Centrarchus sparoides.
Priacanthus macrophthalmus.
Therapon servus.
Trachinus vipera.
Trachinus draco.
Uranoscopus scaber.
Pomotis gibbosus.
Polynemus paradiseus.
Sphyræna spet.
Sphyræna barracuda.
Mullus barbatus.

Fam. 2. *Cataphracti.*

Trigla cuculus.
Trigla lyra.
Prionotus carolinus.
Platycephalus insidiator.
Dactyloptera volitans.
Cottus gobio.
Aspidophorus europæus.
Monocentris japonicus.
Gasterosteus trachurus.

Fam. 3. *Sparoidei* incl. *Mænides.*

Sargus annularis.
Sargus ovis.
Chrysophrys aurata.
Pagrus vulgaris.
Pagellus centrodontus.
Boops salpa.
Boops vulgaris.
Dentex vulgaris.
Smaris vulgaris.
Smaris insidiator.
Gerres Plumieri.

Fam. 4. *Sciænoidei.*

Corvina nigra.
Corvina lobata.
Micropogon undulatus.
Otolithus regalis.
Hæmulon formosum.
Pristipoma stridens.

Fam. 5. *Labyrinthiformes.*

Anabas scandens.
Helostoma Temminckii.
Ophicephalus striatus.
Trichopus trichopterus.
Polyacanthus Hasseltii.
Spirobranchus capensis.

Fam. 6. *Mugiloidei.*

Mugil cephalus.
Mugil, spec.
Atherina Humboldtii.
Atherina vulgaris.
Atherina macrophthalma.

Fam. 7. *Notacanthini.*

Mastacemblus pancalus.

Fam. 8. *Scomberoidei.*

Scomber scomber.
Xiphias gladius.
Tetrapturus belone.
Naucrates ductor.
Lampugus pelagicus.

Lampugus siculus.
Seriola, spec.
Chorinemus saltans.
Caranx trachurus.
Caranx carangus.
Centrolophus pompilus.
Lichia glauca.
Equula insidiatrix.
Argyreiosus vomer.
Vomer Brownii.
Zeus faber.
Capros aper.
Coryphæna hippurus.
Astrodermus guttatus.
Tetragonurus Cuvieri.

Fam. 9. *Squamipennes.*

Scatophagus argus.
Holacanthus, spec.
Toxotes jaculator.
Ephippus faber.

Fam. 10. *Tænioidei.*

Lepidopus argyreus.
Trichiurus haumela.
Trachypterus tænia.
Trachypterus repandus, *Costa.*
Trachypterus Spinolæ.
Cepola rubescens.

Fam. 11. *Gobioidei* et *Cyclopteri.*

Gobius capito.
Gobius cruentatus.
Gobius longiradiatus, *Risso.*
Amblyopus Hermannianus.
Eleotris humeralis.
Tripauchen vagina.
Anarrhichas lupus.
Lepadogaster Gouani.
Echineis remora.

Fam. 12. *Blennioidei.*

Blennius gattorugine.
Blennius Montagui.
Blennius galerita.
Salarias quadricornis.
Cristiceps, spec.
Clinus argenteus.
Callionymus lacerta.

Fam. 13. *Pedunculati.*

Lophius piscatorius.
Chironectes histrio.
Malthe vespertilio.
Batrachus tau.

Fam. 14. *Theutyes.*

Naseus longicornis.
Acanthurus nigricans.
Amphacanthus javus.

Fam. 15. *Fistulares.*

Fistularia tabaccaria.
Fistularia immaculata.
Centriscus scolopax.
Aulostoma sinense.
Amphisile scutata.

Ordo II. Anacanthini, *J. Müll.*

Fam. 1. *Gadoidei.*

Gadus æglefinus.
Gadus morrhua.
Lota vulgaris.
Motella tricirrhata.
Lepidoleprus trachyrhynchus.

Fam. 2. *Pleuronectides.*

Rhombus maximus.
Rhombus podas.
Platessa flesus.
Plaguria, spec.
Achirus mollis.

Fam. 3. *Ophidini.*

Ophidium barbatum.
Fierasfer imberbis.
Ammodytes tobianus.

Fam. 4. *Leptocephalidæ,* Bp.

Helmichthys punctatus.
Oxystomus hyalinus.
Leptocephalus pellucidus, *Bp.*
Hyoprorus messanensis, *Köll.*

Ordo III. Pharyngognathi, *J. Müll.*

Fam. 1. *Labroidei cycloidei.*

Labrus variegatus.
Labrus scrofa.
Julis vulgaris.
Julis pavo.
Crenilabrus pavo.
Xirichthys novacula.
Scarus creticus.

Fam. 2. *Labroidei ctenoidei.*

Pomacentrus fuscus.
Dascyllus araucanus.
Heliases castaneus.
Glyphisodon rhati.

Fam. 3. *Chromides.*

Chromis nilotica.
Chromis surinamensis.
Chromis, spec.
Cichla Deppii.

Fam. 4. *Scomberesoces.*
Belone vulgaris.
Belone caudimacula.
Tylosurus imperialis, *Bp.*
Sayris Camperi.
Hemirhamphus, spec.
Exocœtus exsiliens.

Ordo IV. Physostomi, *J. Müll.*

Fam. 1. *Siluroidei.*

Subfam. *Eremophilini*, Bp.
Trichomycterus punctulatus.

Fam. 4. *Cyprinodontes.*
Pœcilia vivipara.
Anableps tetrophthalmus.
Cyprinodon calaritanus.
Mollienesia latipinnis.
Orestias tæniatus.
Fundulus nigrescens.

Fam. 6. *Esoces.*
Esox vulgaris.
Umbra Krameri.

Fam. 7. *Galaxiæ.*
Galaxias truttaceus.

Fam. 9. *Scopelini.*
Saurus lacerta.
Myctophum elongatum, *Bp.*
Ichthyococcus Poweriæ, *Bp.*
Gonostoma denudata, *Raf.*
Argyropelecus hemigymnus, *Cocco.*
Odontostoma Balbo.

Fam. 10. *Chauliodontidæ*, Bp.
Chauliodus setinotus, *Schn.*
Stomias barbatus, *Risso.*

Fam. 12. *Heteropygii.*
Amblyopsis spelæus.

Fam. 15. *Symbranchii.*
Symbranchus marmoratus.
Symbranchus immaculatus.
Amphipnous cuchia.
Monopterus javanicus.

Ordo V. Plectognathi.

Fam. 1. *Balistini.*
Balistes capriscus.
Monacanthus geographicus.
Aluteres lævis.
Triacanthus brevirostris.

Fam. 2. *Ostraciontes.*
Ostracion triqueter.

Fam. 3. *Gymnodontes.*
Diodon, spec.
Tetraodon fahaca.
Tetraodon lineatus.
Orthagoriscus mola.

Ordo VI. Lophobranchii.
Syngnathus typhle.
Hippocampus guttulatus.
Pegasus draco.

II. *Fishes whose bones contain bone-corpuscles.*

Subclassis I. **Teleostei**, *J. Müll.*

Ordo I. Acanthopteri.

Fam. 8. *Scomberoidei.*
Thynnus vulgaris.
Thynnus alalonga.
Auxis bisus.

Ordo IV. Physostomi.

Fam. 1. *Siluroidei.*
Silurus glanis.
Silurus bicirrhis.
Schilbe mystus.
Synodontis serratus.
Malapterurus electricus.
Malapterurus beninensis.
Heterobranchus anguillaris.
Chaca lophioides.
Plotosus unicolor.
Clarias fuscus.
Pimelodus, spec.
Arius, spec.
Bagrus, spec.
Callichthys, spec.
Loricaria cataphracta.
Auchenipterus furcatus.
Heteropneustes fossilis.
Aspredo lævis.

Fam. 2. *Cyprinoidei.*
Phoxinus lævis.
Cobitis barbatula.
Aspius bipunctatus.
Alburnus lucidus.
Gobio fluviatilis.
Rhodius amarus.
Cyprinus carpio.
Abramis blicca.

Leuciscus rutilus.
Leuciscus tincella.
Tinca chrysitis.
Barbus vulgaris.
Barbus elongatus.
Barbus obtusirostris.
Barbus marginatus.
Chondrostoma risella, *Ag.*
Dangila lipocheila.
Labeo niloticus.
Catostomus, spec.

Fam. 3. *Characini.*

Citharinus Geoffroyi.
Distichodus niloticus.
Hydrocyon Forskahlii.
Alestes dentex.
Tetragonopterus mexicanus.
Anodus cyprinoides.
Leporinus, spec.
Pacu tæniurus.
Pacu nigricans.
Erythrinus unitæniatus.
Macrodon trahira.
Piabuca bimaculata.
Gasteropelecus sternicla.
Chirodon, *Girard*, n. spec.
Brycon, *Müll. Tr.*, n. spec.

Fam. 5. *Mormyri.*

Mormyrus bane.
Mormyrops anguilloides.
Mormyrus longipinnis.
Mormyrus oxyrhynchus.
Mormyrus cyprinoides.
Mormyrus, spec.

Fam. 8. *Salmones.*

Salmo salar.
Salmo trutta.
Argentina silur.

Fam. 11. *Clupeini.*

Clupea harengus.
Alosa vulgaris.
Alosa melanura.
Coilia Grayi.
Engraulis encrasicholus.
Engraulis Brownii.
Notopterus Pallasii.
Macrostoma angustidens, *Risso.*
Meletta thryssa.
Elops saurus.
Megalops cyprinoides.
Chatoessus cepedianus.
Chatoessus punctatus.
Gnathobolus mucronatus.
Chirocentrus dorab.
Pristigaster, spec.
Lutodeira chanos.
Butirinus macrocephalus.
Hyodon claudulus.
Heterotis niloticus.
Osteoglossum Vandellii.
Osteoglossum formosum.
Sudis gigas.
Alepocephalus rostratus.

Fam. 13. *Murænoidei.*

Anguilla vulgaris.
Conger myrus.
Ophisurus serpens.
Nettastoma melanura.
Sphagebranchus imberbis.

Fam. 14. *Gymnotini.*

Gymnotus electricus.
Carapus brachyurus.

Subclassis II. **Ganoidei.**

Ordo I. Holostei.

Fam. 1. *Lepidosteini.*

Lepidosteus platyrhynchus.

Fam. 2. *Polypterini.*

Polypterus bichir.

Fam. 3. *Amiidæ.*

Amia calva.

Ordo II. Chondrostei.

Fam. 1. *Acipenserini.*

Acipenser nacarii.
Scaphyrhynchus Rafinesquii.

Fam. 2. *Spatulariæ.*

Spatularia folium.

Subclassis III. **Dipnoi.**

Fam. 1. *Sirenoidei.*

Lepidosiren annectens.

From these facts it follows that the osseous fishes, notwithstanding their great number, are separated in a very remarkable way into two groups, as shown in the following enumeration :—

Fishes with bone-corpuscles.	*Fishes without bone-corpuscles.*
I. All the extensive and higher-organized tribes of *Physostomi*, J. Müll.; viz. the Siluroidei (except *Trichomycterus*). Cyprinoidei. Characini. Mormyri. Salmones. Clupeini. Murænoidei. Gymnotini.	I. All the numerous tribes of the *Acanthopteri*, with the exception of the genus *Thynnus*.
II. All the *Ganoidei*.	II. All the *Anacanthini*, J. Müll.
III. The *Sirenoidei*.	III. The *Pharyngognathi*, J. Müll.
IV. Of the *Acanthopteri*, only the genus *Thynnus*, Cuv.	IV. Some smaller and lower-organized tribes of *Physostomi*, as the Cyprinodontes. Esoces. Galaxiæ. Scopelini. Chauliodontida, *Bp*. Heteropygii. Symbranchii. And of the Siluroids, only the genus *Trichomycterus*.
	V. The *Plectognathi*.
	VI. The *Lophobranchii*.

As there can be no doubt that most of the higher-organized fishes are amongst those with bone-corpuscles, and as we know that amongst the higher vertebrata, even the lowest, viz. the Perennibranchiata, possess real osseous tissue, it seems to follow that the peculiar distribution of real osseous tissue and of the "osteoid" structure, as the osseous tissue without corpuscles may be called, has a deeper signification. This will be found by studying the development of the bones in both groups; and I hope to be able, before long, to present to the Royal Society some new facts with regard to this matter also; but in the mean time, until my observations are more complete, I must abstain from further explanation.

The facts exposed hitherto have had reference only to a great and fundamental structural difference between two extensive groups of osseous fishes. I may now add, that there exist also greater or lesser structural discrepancies amongst the different tribes of each group. But as this is not a suitable occasion for an exposition of the details of this question, I will only say this much:—In the higher fishes, those with real osseous tissue, there exist differences, especially with regard to the *form* and *size* of the bone-corpuscles; and I hope to be able to show that there are peculiar and tolerably well characterized types of them amongst the Ganoids, Siluroids, *Salmonidæ*, Cyprinoids, *Clupeini*, &c. In the second group there are more varieties. In some tribes the bones are quite structureless homogeneous masses, as in the *Leptocephalidæ*; in others they have a peculiar fibrous appearance, and consist of a singular mixture of cartilage and osteoid structures, as Quekett first showed in the genera *Orthagoriscus* and *Lophius*, to which I may add some *Balistini*; but in the great majority of the tribes of this group, the bones contain peculiar *tubes* more or less similar to those of dentine. If these

tubes are well developed, the bones acquire a structure *which can in no way be distinguished from that of dentine,*—a fact, which also did not escape the perspicacity of Quekett, who mentions its occurrence in the genus *Fistularia,* the Barracuda Pike (*Sphyræna barracuda*), and the Gar-fish (*Belone vulgaris*). I found the same structure in many other genera of this group, especially among the *Plectognathi, Pharyngognathi, Sparidæ,* and *Squamipennes*; but in the greater number this tubular structure is not so well developed, and is intermingled with more structureless parts. Another fact deserving of mention with regard to the bones of this group is, that there very frequently occur also structures, formed by the agglomeration of calcareous globules of different sizes, which resemble in a remarkable degree the lower layers of common fish-scales.

My observations have also extended to the *hard structures of the skin* of fishes, and of *the rays of the fins*; and I may say that in general the same laws, which apply to the structure of the endoskeleton, hold good also for the exoskeleton. Evidence of this is especially afforded by the fins, the rays of which, independently of their hard or soft condition, contain bone-corpuscles in all the tribes where the internal bones are provided with them, whilst in the other case these rays are formed of a homogeneous osteoid substance or of a tubular structure, which may also in some fishes, as Williamson first showed in the Ostracionts, assume the structure of real dentine, as in many Plectognaths (*Triacanthus, Monacanthus, Aluteres, Tetraodon,* and others), and in certain *Acanthopterygii* (*Equula, Ephippus, Hæmulon, Pristipoma, Scatophagus, Centrarchus*). With regard to the skin, we may at least go so far as to say that in no fish whose endoskeleton is destitute of bone-corpuscles do they exist in the hard structures of the skin; but, on the other hand, the tribes which have real osseous tissue do not all present it also in the skin. Scales or plates with bone-corpuscles are found amongst living Ganoids, *e. g.* in *Polypterus, Lepidosteus,* and even *Amia* (in whose scales J. Müller erroneously supposed them to be wanting), and also in the *Acipenserini* and *Spatulariæ*; they exist also in the fossil Ganoids, as the excellent observations of Williamson have shown.

In many Ganoids, moreover, as Williamson and Quekett have shown, the scales often contain dentinal tubes, or even portions of real dentine ("Kosmine" of Williamson) amidst true bone. In the scales of *Lepidosiren,* also, I find bone-corpuscles, but mostly fusiform, and only here and there having a simple stellate figure. Of the other fishes which have bone-corpuscles in their skeleton, little has hitherto been noted as to the coexistence of such corpuscles in their scales, but I find it to prevail to a considerable extent among them. The presence of bone-corpuscles has been long known, it is true, in the larger scales of the "corselet" of *Thynnus,* also in the dermal plates of certain Siluroids (*Loricaria* and *Callichthys*), and was pointed out by J. Müller in the scales of *Sudis.* Leydig, too, states that true bone-corpuscles exist in the walls of the grooves and semicanals upon the scales of the lateral line in certain Cyprinoids (Carp, Tench, and Barbel). This statement I am able fully to con-

firm, and to add the following genera in which I find the same thing to occur; viz.—*Hydrocyon*, *Alepocephalus*, *Macrostoma*, Risso, *Piabuca*, *Serrasalmo*, *Xiphorhamphus*, *Tetragonurus*, *Salminus*, *Chalcinus*, *Pygocentrus*, *Labeo*, and *Catostomus*. But, besides the instance of *Sudis* and certain Siluroids above referred to, I find that many other *Physostomi* have true bone-corpuscles in their scales; not only those of the lateral line, but all of them. From the results of my examinations up to this time, which, however, on account of the want of materials, are by no means complete, I am able to make out the following list:—

1. Characini.

Of this family I have had the means of examining nearly all the genera, including forty-one species.

Characini with bone-corpuscles in all their scales.

Erythrinus unitæniatus, *Spix*.
Erythrinus microcephalus, *Agass*.
Macrodon trahira, *J. Müll.*
Macrodon auritus, *Val.*
Pacu tæniurus (Prochilodus tæniurus, *Val.*).
Pacu nigricans, *Spix*.
Pacu lineatus, *Val.*
Distichodus niloticus, *Müll. Tr.*
Alestes dentex, *Müll. Tr.*
Anodus cyprinoides, *Müll. Tr.*
Anodus edentulus, *Agass*.
Anodus leucos, *de Fil.*
Schizodon fasciatus, *Agass*.
Chilodus punctatus, *Müll. Tr.*
Rhaphiodon (Cynodon) vulpinus, *Agass*.
Leporinus fasciatus, *Müll. Tr.*
Leporinus elongatus, *Val.*
Citharinus latus, *Ehr.*

Characini without bone-corpuscles in their scales.

*Hydrocion Forskahlii, *Cuv.*
*Piabuca bimaculata (*Hyrtl. misit*).
Gasteropelecus sternicla, *Bl.*
Gasteropelecus securis, *de Fil.*
Cheirodon Girard, nov. sp., *de Fil.*
Brycon falcatus, *Müll. Tr.*
Brycon, nov. sp., *de Fil.*
Serrasalmo rhombeus, *Cuv.*
*Serrasalmo marginatus, *Val.*
Xiphorhamphus falcatus, *Müll. Tr.*
*Xiphorhamphus hepsetus, *Müll. Tr.*
Myletes rubripinnis, *Müll. Tr.*
Myletes rhomboidalis, *Cuv.*
Tetragonurus mexicanus, *de Fil.*
*Tetragonurus argenteus, *Art.*
*Tetragonurus maculatus, *Müll. Tr.*
*Salminus Orbignyanus, *Val.*
*Chalcinus Mülleri, *de Fil.*
Pygocentrus nigricans, *Müll. Tr.*
Epicyrtus gibbosus, *Müll. Tr.*
Piabucina erythrinoides, *Val.*
Exodon paradoxus, *Müll. Tr.*
Leporinus, spec.

With regard to the members of the second division, it is to be observed, that probably in all of them the canals attached to the scales of the lateral line are formed of true osseous tissue; in those marked with an asterisk I have found this by actual examination.

The *Characini* are thus divisible into two groups, according to the nature of their scales; at the same time, these are not to be regarded as natural divisions in other respects, and the less so as one and the same genus, such as *Leporinus*, for example, may include species which differ in the composition of their scales. The presence of corpuscles, though connected partly with the size of the scales, does not depend solely on this, for they may be wanting in large scales

(*Hydrocyon, Chalcinus, Salminus*), and present in small ones (*Anodus edentulus, Chilodus*).

2. Mormyri.

Mormyrus longipennis, *Rüpp.*
Mormyrus oxyrhynchus.
Mormyrus bane.
Mormyrus cyprinoides.
Mormyrus, spec.
Mormyrops anguillaris.

3. Clupeini.

Megalops cyprinoides.
Elops saurus.
Coilia Grayi.
Notopterus Pallasii (corpusc. very scanty).
Butirinus macrocephalus.
Hyodon claudulus.
Osteoglossum Vandelii.
Osteoglossum bicirrosum.
Heterotis niloticus.

The plates of the abdominal carina in many *Clupeini* are formed throughout of true bone, but do not belong to the present category.

I am unable to find corpuscles in the scales of *Lutodeira chanos, Chatoessus punctatus* and *cepedianus*, and *Alosa vulgaris*. In several Cyprinoids (*Labeo, Catastomus, Barbus*), I have, in like manner, failed to discover corpuscles in the scales proper; on the other hand, I have found very distinct dentinal tubes in the scales of *Barbus*, at their hinder part.

True osseous tissue will doubtless hereafter be found in the scales of many other *Physostomi* which have it in their skeleton, but it is not to be supposed that this will apply to all.

In the *Physostomi*, as in the Ganoids, the bone-corpuscles lie in the lower stratum of the scale; still they are situated above the fibrous layer, and immediately beneath the structureless layer, to which in all scales I apply the name of "ganoin-layer," inasmuch as it has in all cases the same signification.

From the foregoing observations we are able to show still more positively than could be done by J. Müller, that the scales of Ganoids have no peculiarity of structure to distinguish them from those of the *Teleostei*. Nay, certain Ganoids, as *Amia*, have scales, which in respect even of pliancy, rounded contour, and the surface-marking of the ganoin-layer, agree with those of other fishes.

In reference to those fishes which want bone-corpuscles in their skeleton, I have still to remark,—1, that the corpuscles are also invariably wanting in the semicanals upon the scales of the lateral line; for what Leydig designates as rudimentary bone-corpuscles in the Perch are in fact the tubules of the osteoid substance; 2, that amongst the group of fishes in question, there are some which have beautiful dentine in their skin-bones, *e. g. Amphisile scutata* and the Ostracionts.

To the foregoing remarks on the microscopic structure of the hard tissues of fishes, I may add, that there also exists a third group of fishes, in which the endoskeleton is composed only of common cartilage, or of cartilage with depositions of earthy salts, viz. the *Cyclostomi* and *Selachii*. None of these fishes, not even the *Plagiostomi* and *Chimæra*, possess real bone-cells in their hard parts; for these are formed only, as J. Müller showed many years ago, by ossified

cartilage, that is to say, cartilage-cells in an ossified matrix. Even the hard spines of the fins and of the skin of these animals are not real bone, but dentine, as was demonstrated long since by Agassiz and Quekett.

If now we sum up all that has been said, we arrive at the following conclusions:—

I. There exist *three types* of structure in the skeleton of fishes, viz.:

1. *Type of the Selachii.*
The skeleton is formed of cartilage or ossified cartilage.
Selachii, Cyclostomi.

2. *Type of the Acanthopterygii.*
The skeleton is formed of a homogeneous or tubular osteoid substance, often of true dentine.
Teleostei (*J. Müll.*), with the exception of the greater part of the Physostomi (*J. Müll.*).

3. *Type of the Ganoidei.*
The skeleton is formed of real osseous tissue.
Most of the Physostomi, the Ganoidei, and Sirenoidei.

II. The *exoskeleton* follows in some respects the same laws as the endoskeleton, and shows the following types:—

1. *Exoskeleton formed of a homogeneous and fibrous osteoid substance.*
Scales of the majority of the Teleostei.

2. *Exoskeleton formed of dentine.*
Spines of Selachii and scales of Plectognathi, and of *Amphisile*, in part.

3. *Exoskeleton formed of real bone*; partly in association with homogeneous osteoid substance (*ganoin*) and dentinal tubes.
Scales of Ganoidei, of *Lepidosiren*, some Siluroidei, of Mormyri, many Characini and Clupeini, also of *Thynnus*.

In terminating this communication, I think it proper to mention that the great liberality with which my friend Mr. Tomes of London, and Professor Williamson of Manchester, put their large collections of microscopic preparations of teeth, bones, and scales at my disposal, proved of great assistance in my investigations, and, accordingly, I am only fulfilling an agreeable duty in now publicly expressing my obligations to them. I am also greatly indebted to my friends Filippo de Filippi of Turin and Henry Müller of Würzburg, also to Dr. Hyrtl of Vienna, and Dr. Peters of Berlin, who supplied me with many of the rarer Mediterranean and foreign fishes. But, in order that my observations may yield the results which may not unreasonably be expected from them, I need more aid; and as England is the country in which not only the largest zoological collections of fishes, but also the greatest number of microscopic preparations of the hard tissues of recent and fossil animals, are to be found, I take

the liberty to ask the possessors of such collections who may be interested in this matter to favour me with such specimens as may seem to them calculated to give to this series of observations the greatest possible extension.

GEOLOGICAL SOCIETY.

April 20, 1859.—Major-General Portlock, V.P., in the Chair.

"On some Reptilian Remains from South Africa." By Prof. Owen, F.R.S., F.G.S.

Fam. Crocodilia. *Galesaurus planiceps*, the Flat-headed Galesaur (from γαλῆ, polecat, σαῦρος, lizard), a genus and species founded on an entire cranium and lower jaw. The skull in length less than twice the breadth, much depressed, and flat above. Occipital region sloping from above backward, divided by a high and sharp ridge from the temporal fossæ; these are wide and rhomboidal; orbits small; nostril single and terminal. Dentition, $i. \frac{4-4}{3-3}$, $c. \frac{1-1}{1-1}$, $m. \frac{11-11}{12-12}$; all the teeth close-set, except the intervals for the crowns of the long canines when the mouth is closed. Canines of the shape and proportions of those in *Mustela* and *Viverra*, without trace of preparation of successors in the sockets; of quite mammalian character. Incisors longish and slender, molars subcompressed; both with simple pointed crowns, of equal length, and undivided roots. Original transmitted to the British Museum by Governor Sir George Grey, K.C.B. From the sandstone rocks, Rhenosterberg.

Cynochampsa laniarius, the Dog-toothed Gavial (from κύων, dog, and χάμψαι, Egyptian name for Crocodiles, applied by Wagner to the Indian Gavial). This genus and species is founded on the rostral end of the upper and lower jaws of a Crocodilian Reptile, with a single terminal nostril, situated and shaped as in *Teleosaurus*, and indicating similarly long and slender jaws. Only the incisive and canine parts of the dentition are preserved; but these closely correspond with the same parts in *Galesaurus*, the incisors being equal and close-set, of simple conical form, and the canines suddenly contrasted by their large size. In shape they resemble closely the completely formed canines in Carnivorous Mammals. There is no trace of successional teeth. Original transmitted to the British Museum by Governor Sir George Grey, K.C.B., from Rhenosterberg, South Africa.

Fam. Dicynodontia. Subgenus *Ptychognathus*, Ow. (πτυχὸς, ridge, γνάθος, jaw).—This subgenus is founded on four more or less entire skulls, two retaining the lower jaw, referable to two species.

Ptychognathus declivis, Ow.—Plane of occiput meeting the upper (fronto-parietal) plane at an acute angle, rising from below upward and backward, as in the feline mammals; fronto-parietal plane bounded by an anterior ridge, extending from one superorbital process to the other; from this ridge the facial part of the skull slopes downward in a straight line, slightly diverging from the parallel of the occipital plane; superoccipital ridge much pro-

duced and notched in the middle; the occipital plane, owing to the outward expansion of the mastoid plates, is the broadest part of the skull, which quickly contracts forward to the ridged beginnings of the alveoli of the canine tusks; orbits oblong, reniform, suggestive of the reptile having the power of turning the eyeball, so as to look upward and backward as well as outward. Remains of sclerotic plates. Nostrils divided by a broad, flat, upward production of premaxillary, situated nearer the orbit than the muzzle, smaller than in type *Dicynodon*; temporal fossæ broader than long, and with the outer border longest; palate with single large oval vacuity, bounded by palato-pterygoid ridges; occipital hypapophyses proportionally thicker than in *Dicynodon tigriceps*; no trace of median suture in parietal, which is perforated by a 'foramen parietale;' frontals divided by a median suture and supporting a transverse pair of small tuberosities; anterior boundary-ridge of vertex formed by the nasals and prefrontals, the outer surface of both being divided into a horizontal and sloping facet; lacrymal bone extending from fore-part of orbit half an inch upon the face to the nostril; premaxillary long and single, its median facial tract flat, with a low median longitudinal ridge; maxillaries forming the lower boundary of the nostrils, and uniting above with the prefrontal, lacrymal, and nasal bones, their outer surface divided by the strong ridge suggesting the subgeneric name; teeth of the upper jaw restricted to the two canine tusks, the sockets of which descend much below the edentulous alveolar border; lower jaw edentulous, deep, and broad, with the fore-part of the symphysis produced and bent up to meet the seemingly truncate end of the premaxillary,—a character indicating, with the angular outline of the skull, the subgeneric distinction.

Ptychognathus verticalis.—The skull of this species, repeating the subgeneric characteristics of the foregoing, has the facial contour descending almost vertically from, and at almost a right angle with, the fronto-parietal plane. Orbits proportionally larger and more fully oval. Ridged sockets of the canine tusks descending more vertically from below the orbits. Originals transmitted to the British Museum by Governor Sir George Grey, K.C.B., from Rhenosterberg, South Africa.

Subgenus *Oudenodon*, Bain (*οὐδείς*, none, *ὀδούς*, tooth).—The skull in this subgenus presents the divided nostrils, the structure and the rounded contours of that of the true *Dicynodons*; also the same form, relative size, and position of the orbits and nostrils; but the zygomatic arches are more slender, straight, and long; and, although there be an indication of an alveolar process of the superior maxillary, the lower part of which projects slightly beyond the rest of the edentulous border of the jaw, it does not contain any trace of a tooth, so that both jaws are edentulous,—a character which had attracted the attention of their discoverer, Mr. Bain, who, in indicating it, proposed the name *Oudenodon*.

It is permissible to speculate on the possibility of these toothless ynodontoids being, aftɜr the analogy of th Narwhals, the

females; or of their being individuals which had lost their tusks without power of replacing them, as the known structure of the true Dicynodons indicates. But there are characters of the zygomatic arches and temporal fossæ which differentiate the toothless skulls sufficiently to justify their provisional reference to a distinct subgenus.

Hyoid apparatus of *Oudenodon*.—Beneath one of the skulls, and imbedded in the matrix between the mandibular rami, were the following elements of the hyoid apparatus:—basi-hyal, cerato-hyals, thyro-hyals (or hypo-branchials), cerato-branchials, and uro-hyal.

The cerato-hyals are long, subcompressed, expanded at both ends; the thyro-hyals shorter and more slender; the cerato-branchials with a sigmoid flexure; the uro-hyal symmetrical, broad, flat, semicircular, with a production like a stem from the middle of the straight anterior margin. This apparatus shows the complexity by which the hyoid in Lizards and Chelonians differs from the hyoid in Crocodiles, and combines Chelonian with Lacertian characters. Transmitted by Mr. Bain from South Africa.

Dicynodon tigriceps.—Pelvis: ilium, ischium, and pubis coalesced to form an 'os innominatum,' with the suture at the symphysis obliterated. At least five sacral vertebræ; the first with broad, thick, triangular, terminally expanded pleurapophyses. The strong, straight, trihedral ilium overlies the above sacral rib, and extends forward to overlie also the last long and slender rib of the free trunk (thoracic) vertebræ. There are no lumbar vertebræ.

Pubis very thick, strong, with a broad anterior convexity resembling that of the *Monitor* in its internal perforation and external apophysis; ischium receiving the abutment of the last two pairs of sacral vertebræ.

The form of the anterior aperture of the pelvis is oval, with the sides broken by a slight angle at the middle, and the small end encroached upon by the slight angular prominence of the symphysis pubis. The long diameter is 11 inches (from the fore-end of the first sacral vertebra), the transverse diameter is 10 inches. The fore-half of this aperture is bounded by the first sacral vertebra exclusively, at the middle by its centrum, at the sides by its ribs; the hind-half of the aperture is bounded by the pubic bones. From the penultimate sacral vertebra to the symphysis pubis it measures 5 inches.

The outlet of the pelvis is of a semielliptic form, 9 inches in transverse, and 4 inches in the opposite diameter. Original transmitted by Mr. Bain from East Brink River, South Africa.

Crocodilia (?). Genus *Massospondylus*, Ow. (Gr. μάσσων, longer; σπόνδυλος, vertebra).—The author exhibited diagrams, and pointed out the characters on which he had founded (in the Catalogue of Fossil Remains of the Museum of the College of Surgeons) the genus *Massospondylus*, exemplified by the *M. carinatus*.

Genus *Pachyspondylus*, Ow. (Gr. παχὺς, thick; σπόνδυλος, vertebra).—The fossils exemplifying this genus form part of the same collection, obtained by Messrs. Orpen from sandstones of the Drakenberg range of hills, South Africa, and presented to the College of Surgeons.

MISCELLANEOUS.

Occurrence of Rhinolophus Hipposideros *in Ireland.*

To the Editors of the Annals of Natural History.

Dublin, April 14, 1859.

GENTLEMEN,—Perhaps it may be of interest to state that the Lesser Horse-shoe Bat (*Rhinolophus Hipposideros*) has been met with in some numbers in a cave near the town of Ennis, county of Clare, last month, by Mr. F. J. Foot. The cave is called Balliallia, and is one of the numerous hollows that occur in the Carboniferous limestone of that county and of Kerry, &c. The paper being the first record of its discovery in Ireland was read by Professor Kinahan at a meeting of the Dublin Natural History Society, held on Friday the 1st of April.

So few of the Bat tribe have hitherto been recorded in this country, compared with those occurring in England, that a notice of it may be interesting. Professor Bell has confirmed the correctness of the species.

I am, Gentlemen, your most obedient Servant,

F.

Saxicava rugosa *a Byssus-spinner.* By DAVID ROBERTSON.

To the Editors of the Annals of Natural History.

Glasgow, June 14, 1859.

GENTLEMEN,—I beg to offer the following observations in confirmation of Mr. West's paper in the last Number of the 'Annals,' as to *Saxicava rugosa* being a byssus-spinner.

Last year, in the month of March, I had a *Saxicava rugosa* (length of shell $1\frac{2}{16}$ inch, breadth $\frac{9}{16}$ths of an inch), which span freely, but in this instance did not use the byssus to secure a permanent attachment to any particular site and prevent a change of position while the continuity of the cord held good, as is the case with the common Mussel, but seemingly as a cable to fix and hold fast by in its wanderings, with a power to give it out at pleasure.

On the 16th of March the animal was placed in a six-ounce wide-mouthed vial. On the 17th it had attached two filaments to the glass. On the 22nd it had shifted half an inch forward, and given out as much cable as allowed the desired advance. At this stage it fixed the cord to the glass, close by the shell, by two other short filaments. On the 28th it moved still further forward, giving out more cable, and again fixing it by more filaments, as before.

At that time, not being aware that the spinning-properties of *Saxicava rugosa* were unknown to conchologists, and having no other object in view than securing the byssus for the microscope and the shell for my cabinet, my observations terminated.

I am, Gentlemen, your obedient Servant,

DAVID ROBERTSON.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 20. AUGUST 1859.

VII.—*On the Laws of Evolution of the Organic World during the Formation of the Crust of the Earth.* By H. G. Bronn*.

Under the above title, Bronn has just published, in German, his prize-essay sent to the Academy of Sciences of Paris. This memoir was prepared in response to a question proposed in 1853 by that Academy, and referred to the concourse in 1854, in the following form:—

"Study the laws of the distribution of fossil organic bodies in the different sedimentary strata according to the order of superposition:

"Discuss the question of their successive or simultaneous appearance and disappearance:

"Investigate the nature of the relations existing between the present state of the organic kingdom and its former states."

The Academy has indeed decided that Bronn's important work shall be printed; but, in accordance with the usages and customs of that Institution, we shall still, no doubt, have to wait some years to see the completion of its printing. Fortunately, M. Bronn has indulged us with a German translation of his memoir, which has the advantages over the original, in the first place, of being published, and, in the second, of being augmented by a multitude of notes, which place this work at the level of the state of science in 1858.

In place of making an analysis of this remarkable work, we have thought it best to submit to our readers a complete trans-

* From "Untersuchungen über die Entwickelungsgesetze der organischen Welt während der Bildungszeit unserer Erdoberfläche." Stuttgard, 1858. Translated by W. S. Dallas, F.L.S., from the Bibliothèque Universelle de Genève, 20th March, 1859, Archives des Sciences physiques et naturelles, p. 217.

lation of the last chapter, in which M. Bronn himself gives a summary of the essential results at which he has arrived.

E. Claparède.

I. *Results of the investigations of* M. Bronn *with regard to the distribution of fossil organisms in the natural series of sedimentary strata.*

The investigations contained in this work are a confirmation of the laws resulting from the purely geological study of the evolution of the crust of the earth in relation to the successive appearance of organized beings. They also bring to light certain facts which do not immediately result from those laws, although they are not in contradiction to them—facts which particularly deserve attention.

First fundamental law.

1. Organisms have made their appearance, in the sequence of time and in different localities, in conditions of type and number which were in relation to the external conditions of existence.

2. The appearance of the two organized kingdoms was simultaneous. It dates almost immediately from the first Neptunian deposits—that is to say, from an epoch when the central heat must have still exercised a considerable influence upon the surface of the globe. It was undoubtedly, from the first, the business of the organisms of both kingdoms to maintain the atmosphere in such a state that the proportions of oxygen and carbonic acid might be as favourable as possible to their own development, at least if we suppose that the chemical composition of the atmosphere was already constant and independent of other circumstances (*vide* 8).

3. The population of the surface of the earth was, originally, very uniform in all latitudes. It is only towards the middle of the tertiary period that we see the floras and faunas become essentially differentiated according to zones.

4. Both as regards its constitution and number, the primitive population of the surface of the earth corresponded with a hot climate, of tropical nature, uniform throughout the year. This results from the very fact that the climatic differences of the different zones were not manifested until a later period, in consequence of a refrigeration starting from the polar regions.

5. All the successive modifications of the animal and vegetable population of the surface of the globe have been effected by the annihilation of the older species and the continual appearance of new species, without there having ever been any gradual passage from one species to another.

6. The primitive types, whether animal or vegetable, were

the most widely different of all from those of existing nature. Some of them differed from the latter so much as to form subclasses or orders,—most of them at least generically. But in proportion as, in the history of the earth, we approach the present epoch, we observe a constantly increasing concordance of the genera, or even, in certain cases, an identity of species with our existing nature.

7. In all times there have existed faunas and floras topographically distinct, in consequence of differences of conditions in the stations, by reason of the distribution of the seas and the elevation of mountains. But in proportion as the evolution of the surface of the earth multiplied and varied the conditions of stations, in proportion as seas were divided, continents extended, chains of mountains elongated, and summits elevated, we also see a diversification of the organized types and of their mode of grouping and association. Topographical faunas and floras became more clearly defined; and in all cases the number of species living together constantly became more considerable.

8. Amongst stations of remarkable nature, we must above all indicate the immense marshes of *Stigmaria* in the carboniferous epoch. Thanks to their long and numerous horizontal roots, extended at the surface of the water, the *Stigmaria* appear in course of time to have furnished a multitude of other plants with the soil necessary for their development. The latter on perishing became buried in the marsh, and there, protected from the access of air, became gradually converted into coal, only permitting a small number of fragments to decompose and become rotten at the surface. It is thus that the accumulation of carbonized substances could take place in a comparatively rapid manner (nearly as in our peat-bogs), and the formation of very large strata of coal consequently required a time perhaps less considerable than is usually supposed. The alternations, repeated hundreds of times, of strata of coal and sandstones or argillaceous shales, teach us that at that time a slow and gradual sinking of the soil was taking place, during which the strata of vegetable matter which had just been formed were covered with mud and sand; then the soil rose again. These continual sinkings indicate the existence at this period of plutonic* movements of the crust of the earth, in consequence of which, abundant emissions of carbonic acid might take place during a long period, as we see at present in certain countries.

* It is, however, to be remarked, that such movements of the soil do not necessarily involve plutonic action. The works of MM. Bischoff, Volger, and others appear to show, on the contrary, that sinkings of this nature must, in most cases, have a cause entirely Neptunian.—E. CLAPARÈDE.

It was, then, the business of these marshy forests to seize upon this carbonic acid and to fix its carbon at the bottom of the waters. In fact, if all the carbon contained in the organic substances now deposited in the sedimentary strata in the form of coal, bitumen, &c., had never existed in the atmosphere in the form of carbonic acid, no animal or vegetable life would have been possible. These coaly marshes of *Stigmariæ*, with their peculiar vegetation, seem to have reappeared here and there, when sinkings of the soil, combined with emissions of carbonic acid, again gave rise to similar conditions*.

9. Although the carbonic acid continually emitted was thus incessantly and slowly eliminated by the Stigmaria-forests, it is not the less probable that the cause of the depression of the soil (elevation of temperature), the carbonic acid contained in the air in greater proportion than at the present day, and the great development of the marshes of *Stigmariæ* all over the surface of the globe, must have exercised a very great influence upon the character of the rest of the vegetation. But these are effects which it is no longer possible to analyse, nor to refer with certainty to their particular causes.

10. A multitude of plants and animals, especially more than three-fourths of the terrestrial insects, birds, and mammals, which, either with regard to their food or habitation, are necessarily connected with certain genera, or even certain species of plants, could, of course, only appear after the latter. The inferior plants and animals are often less intimately connected with other organisms than others which are higher in the series.

11. The principal modifications which the external conditions of existence of organisms had to undergo, consisted, undoubtedly, in the division of the universal ocean into several seas, Mediterranean basins and Caspian lakes,—in the emergence of islands which increased in size, or even united with each other to form continents,—in the elevation of mountain-chains, &c. In parallelism with this transformation of the crust of the earth, the organized world presented analogous modifications. The population of the sea, at first entirely pelagic, became combined with a littoral population, then with a terrestrial but exclusively coast population, and lastly with continental populations, varying with flat and mountainous countries. It is this series of phænomena

* This, as far as we know, is the first time that these different conditions, such as the chemical composition of the air, depressions of the soil, the marshes of *Stigmariæ*, and the formation of coal, have been thus combined with each other. This combination seems to us to be equally natural and necessary; still we admit that this opinion would require to be better supported, and that it may undergo some modifications. It is still too new to allow us to develope it sufficiently; perhaps we may do so hereafter.—(*Author's note.*)

that we designate under the name of *terripetal evolution.* Either by the successive sequence of organisms, or by the transformation of their characters, even in cases in which the causes of transformation are unknown to us, this evolution is manifested to us as a perfectly general law of development, which we call the *terripetal law.* As, in general, the inhabitants of coasts are characterized by a higher degree of organization than the inhabitants of the depths of the sea, and the inhabitants of the dry land by a higher degree of organization than those of the waters, this law is intimately connected with a progressive development. The first terrestrial plants* (if we do not take into account the coals of Portugal, the Silurian nature of which is doubtful) date from the Devonian formation; the first amphibious animals make their appearance in very small number at the same epoch†. The first veritable inhabitants of the dry land, respiring air (insects) and walking, make their appearance in the carboniferous formation. From this moment the number of terrestrial organisms constantly increases, and finally predominates over that of the marine organisms.

Second fundamental law.

12. Besides this first law, there evidently exists a positive and *independent* law of creation, which manifests itself to us in the simplicity and perfect order of all the simultaneous or successive modifications of the organized world. The external conditions of existence only permitted the investigation of the plan which presided in the creation at each moment and in all the series of time from a perfectly negative point of view. But this second law, thanks to its positive character, furnishes us with the means of following the conducting clue with far more facility and conclusiveness than was permitted by the former, which is so complex. Hence results, in the first place, the strict uniformity in all the creation which existed simultaneously at each moment upon the whole surface of the earth; hence the simultaneous appearance and disappearance of genera and species in all regions and under every zone; hence the constant equilibrium between the plants and animals, the terrestrial and aquatic animals, the Herbivora and Carnivora in each creation; and all this realised far more exactly than could have happened under the influence of the external conditions of existence alone, which may certainly destroy, but can produce nothing. The unfolding of the plan

* The earliest land-plants now known are those indicated by the Lycopodiaceous seed-vessels and fragments of woody tissue in the uppermost Silurian beds.—Ed. *Annals.*

† If the *Telerpeton* of Elgin be here referred to, we may remark that it is very doubtful if this fossil be of Devonian age.—Ed. *Annals.*

of creation in the series of geological ages has taken place with a perfect consequentiality and in a perfectly independent manner. Systematic and progressive development, and the law which governs it, are facts which can no longer be misconceived. Nevertheless we must not represent this progressive development as consisting in the primitive appearance of the Phytozoa alone, which would be followed by the Actinozoa, then by the Malacozoa, then by the Entomozoa, and finally by the Spondylozoa, each class and each order being followed by the appearance of a class or order occupying a higher place in the scale of organization. In reality, the subkingdoms, for which the external conditions of existence at the most ancient period were sufficient, made their appearance simultaneously, or nearly so. These subkingdoms were represented by the classes and orders lowest in organization—by pelagic, swimming forms, respiring air by means of branchiæ. When, subsequently, the superior subkingdoms were rapidly created one after the other, the classes and orders which had first appeared were represented by types gradually ascending. This is what we observe in many cases, and in all the subkingdoms without exception, when we pass them in review class by class and order by order, so as to prove the period of their appearance and that of their culmination (appearance of the higher plants, the bony fishes, the mammalia).

13. This plan of succession is nowhere more evident than in the vegetable kingdom, in which we see several subkingdoms appear at first and simultaneously, followed by the successive appearance of the superior groups most nearly allied to them in organization, and which only attained their culmination subsequently. The perfectly natural consequence of this, was the comparatively far later appearance of the most highly organized groups of plants—groups which surpass all the others in the number of their genera and species; and yet, at least as far as we can now judge, the external conditions of existence would have permitted their appearance from the very first. It is not possible for us, now-a-days, to ascertain any cause to which may have been due the retardation of the appearance of the angiospermous Dicotyledons until the cretaceous epoch *, except the law of progressive development (at least unless we choose to assume that the emission of carbonic acid in the ancient epochs may have opposed their production).

14. The late appearance of the angiospermous Dicotyledons is undoubtedly, of all causes, that which had the most importance in retarding the appearance of most of the terrestrial animals, such as the insects, birds, and mammalia. In all cases, the

* We must recollect that at least one angiosperm has been quoted from the Coal-measures. See Lyell's 'Manual,' 1855, p. 374.—Ed. *Annals*.

marine omnivorous and carnivorous types, and, amongst the genera or the orders belonging to these classes, those which feed upon Cryptogamia and Gymnospermia, were able to exist at a more ancient period. Amongst the multitude of animals which live at the expense of the angiospermous Dicotyledons, there is, moreover, a great quantity which are dependent upon one another; thus the carnivorous Vertebrata, the coprophagous or parasitic Insects, &c., could only make their appearance after certain other animals.

15. Progressive development does not consist only in the fact that new and more perfect types became added to the inferior types which existed before, but also in the circumstance that these latter decreased in importance from their point of culmination, and finally became entirely extinct. As a matter of course, certain types appeared from the first with their maximum. We consequently find simultaneously in each subkingdom, and even in each class of organized beings, types in course of development and others in course of diminution. The types which have a tendency to disappear are inferior types in regard to their organization or to the terripetal series (for example the Cephalopoda). The types which go on multiplying, on the contrary, occupy a higher place in one or other of these points of view. The groups which tend thus to replace each other are generally met with in the mesolithic period; but sometimes also they are separated by a longer or shorter interval. Besides, there exist groups of organisms of which the numerical development remains nearly the same through all periods. These are, for the most part, inferior orders or suborders, composed, perhaps, sometimes of two groups tending to replace each other.

16. All the great phænomena relating to the order of appearance of the different subdivisions of the organized kingdom result from the laws which we have here developed, and which may be summed up as follows:—*a*, adaptation to external conditions; *b*, terripetal movement; *c*, progressive development, that is to say, the successive appearance of forms with more and more complicated organization. The apparition of all these subdivisions is subordinated to these laws, with the exception of certain groups of secondary importance (suborders or families). Among these few and unimportant exceptions we may cite the late appearance of certain groups of Teleostian fishes, the premature appearance of certain terrestrial Reptiles (Thecodont and Acrodont Lacertians) which preceded the aquatic Saurians (Nexipoda and Emydosauria), and the rapid extinction of the Dinosauria, with so high an organization, at the moment of the appearance of Mammalia*. But these facts are so isolated, that

* As Dinosaurian reptiles occur in the Trias and the Lias, and as small

they can only be regarded as exceptions to the rule. It is nevertheless true that if, in these considerations, we choose to descend to the families of least importance, we shall see these exceptions become multiplied. But although the laws which we have just enumerated have, without the least doubt, presided over the creation, we are far from pretending that they are as mathematically absolute (excepting, of course, the negative and decisive effects of the law of external conditions of existence) as the law of universal attraction, the law of affinity, or any other law which admits of no exception. Moreover we do not yet know what rule the Creator himself has adopted for the determination of the systematic order of creatures.

17. A great number of phænomena certainly appear to fulfil the law of the successive development of series of organisms answering to embryonal types, such as has been formulated by M. Agassiz. Nevertheless the different characters presented by organisms resulting from the metamorphosis of an embryonal type are not all signs of a gradual perfecting. They are variations upon a single theme of organization, upon a single fundamental idea.

18. All the phænomena which we deduce from the law of adaptation to the external circumstances of existence, from the law of terripetal evolution, and from that of progressive development, show us a regular progress from the commencement to the close of geological epochs. Nevertheless there are two moments which, from their importance, stand out by themselves upon this uniform course of the history of the earth—one terminating the palæolithic, and the other immediately preceding the cænolithic period. The former corresponds with the extinction of the marshes of *Stigmaria*: this extinction involved the cessation of peculiar and very general phænomena on the surface of the earth, which were intimately connected with the existence of these singular bogs; it also involved the disappearance of a great number of palæolithic types. The second corresponds with the disappearance of Ammonites and Belemnites,—the first appearance, at all events on a considerable scale, of angiocarpous Dicotyledons, of the Teleostian fishes, of Birds inhabiting trees, and lastly of Mammalia. By this means, the multiplication of the number of genera and species received a fresh impulse. From this moment date the first traces of a differentiation of climates corresponding with the different zones of the terrestrial globe.

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mammals are found so low down as in the Trias, the co-existence of these forms, until the extinction of the Dinosaurs in the Cretaceous era, would appear to have extended over a long period of time,—contrary to the opinion expressed by the author.—Ed. *Annals*.

II. ***Results of investigations regarding the gradation or simultaneousness of the appearance and disappearance of organized beings.***

The results at which we have arrived, with regard to the gradual or simultaneous extinction of all the organisms of a single epoch, may be summed up in the following manner:—

1. The creation of new species and the disappearance of older types went on continuously, with the exception of slight oscillations, without being restricted to certain periods of creation, although it is easy to imagine that certain geological events may have, here and there, induced the simultaneous extinction of a larger or smaller number of species.

2. The duration of existence has been very variable, according to the species. Certain specific types have endured 2, 3, 4, or 5 times as long as others, so that some even existed only during a small fraction of the time necessary for the production of a formation in the geological sense of the word, whilst others survived the deposition of two or three formations, or even more. These phænomena might take place only at a certain point of the surface of the globe, and not present themselves elsewhere.

3. There are, consequently, no definite formations in the palæolithic sense of the word, no definite creations, no successive and well-marked floras or faunas, any more than there exists any formation which simultaneously maintains the same mineralogical characters, the same thickness, and the same lithological and palæontological characters in all parts of the world.

4. A geological formation, or a geological flora or fauna, is the totality of the sedimentary strata which have been formed upon the whole earth during a certain space of time, or the totality of the animals and plants which have lived during that space of time. It is of little consequence here, whether the lithological character, the thickness, and the limits of demarcation of these strata have been uniform over all the surface of the globe, or have varied in different places, assuming here one aspect, there another; it is of little consequence whether the various species of organisms belonging to this epoch may have lived from its commencement to its termination, only endured for a portion of this time, or passed the limits assigned to this formation.

5. When the deposition of identical strata, according with an identical and constant state of the sea, continued longer in one country than in another, the population of this sea and the organic remains of this population might exist there longer without undergoing modification.

6. When an identical state of the sea reappeared during the

deposition of an immediately consecutive formation, or after a longer or shorter interval during which other formations might be deposited, the same marine population might reappear in the same locality and give rise to identical organic *débris*, enclosed in superior strata. Thus are formed what are termed *colonies* in Geology. It is probable, however, that this phænomenon could only present itself when the same species had continued to live in the interval, perhaps exceedingly reduced in number, in some other locality. We have nevertheless shown how it may happen that remains of perfectly identical species may pass into rocks of a nature quite different, and deposited by very different seas.

7. There probably exist no formations immediately superposed upon each other, no consecutive faunas and floras, without certain organisms being common to both. The number of common species may vary between 0·01 and 0·10.

8. When, however, in certain localities there have been sudden movements of the soil, heating of the crust of the earth, emissions of sulphurous vapours, carbonic acid, or other injurious gases, long interruptions in the formation of deposits, upheavals of strata, &c., it most frequently happens that the passage of species from one stratum to another is more rare than when the deposits have been formed regularly and without any interruption.

9. The average absolute duration of organisms was sufficiently long to give us no reason for astonishment at the important differences presented by species in this respect, although the history of these species is often told us only by strata of but slight thickness, so that it often happens that we regard as simultaneous, phænomena which have been separated by long periods of time.

[To be continued.]

VIII.—*Observations on the Shell and Animal of* Hybocystis, *a new genus of* Cyclostomidæ, *based on* Megalomastoma gravidum *and* Otopoma Blennus, *B.*; *with Notes on other living Shells from India and Burmah.* By W. H. Benson, Esq.

Dr. Pfeiffer has divided the genus *Megalomastoma* into three sections:—1st, *Hainesia*, which he considers to be possibly distinct generically; 2nd, *Farcimen*, Troschel; and, 3rd, *Megalomastoma* proper. In the first section, characterized by its oval aperture, angular above, he places the Siamese *M. Myersi*, Haines, *M. crocum*, Sow., and *M. bifasciatum*, Sow. The operculum is unknown. In *Farcimen* he has included my Burmese *M. gravidum*, together with other species provided with the normal thin cor-

neous operculum of *Megalomastoma*, but distinguished by the thickness of the circular peristome from the typical forms.

I am indebted to Capt. Haughton, late magistrate of Moulmein, for two specimens of *M. gravidum*, each with the operculum *in situ*. Its nature and construction at once announced that the separation of the form from *Megalomastoma* was absolutely necessary.. The thick calcareous shield is many-whorled externally, and peculiarly convoluted on the inner surface. The generic term "*Hybocystis*" has reference to the form of the typical shell.

A comparison with the thin, similarly convoluted operculum of *Otopoma Blennus*, B., from the same locality, induced a suspicion that the latter shell was merely the young of *Hybocystis gravida*, notwithstanding the abrupt termination of the last whorl of that part in *O. Blennus*; and finding, on forcibly withdrawing an operculum, that the foot, head, tentacula, and eyes adhering to it were quite fresh and moist, and evidently in a living state, and the operculum of one of the specimens of *Hyb. gravida* opposing even greater resistance to the attempts made to separate it, I took measures for the re-animation of the animal, as well as of other specimens of *O. Blennus*; and, in spite of the apparent emptiness of the whorls, with the exception of a small portion near the aperture, I succeeded in making the animals of both forms move about freely, when their absolute identity in colour and conformation placed the fact of their being the adult and young of the same species beyond a doubt. The form of the now obsolete species, *O. Blennus*, coincides with that of the spire of *Hybocystis gravida* before it assumes its lengthened and distorted phase.

In treating *H. gravida* as the type of a new genus, I have been guided by the following considerations, in addition to the structure and substance of the operculum. The character assigned to *Hainesia*, Pfr., viz. the oval mouth, angulate above (as recorded in the 'Mal. Blätter' for 1856, and partly copied in the 'Monographia Pneum.' Supp. 1858), would at once exclude from that section or genus the Moulmein shell, even if any of the three species included in it, in consequence of possessing that sole feature in common, should be found to be provided with a calcareous operculum. I doubt whether the two West Indian forms in the section will present opercula formed on the same type as that of the Siamese shell with which Dr. Pfeiffer has associated them; but as the diagnosis of the section is quite inapplicable to the Burmese species, I have no hesitation in conferring on the latter a distinct generic appellation. If eventually *M. Myersi* should exhibit an operculum similar to that of *Hybocystis*, it will necessarily have to drop its connexion with *Hainesia*, the name of

Rhaphaulus Chrysalis, Pfr.

Foot oblong, rounded anteriorly, narrowed posteriorly, and rounded at the extremity; muzzle short, declivous, rounded at the front, not emarginate nor lobed; tentacula somewhat short, slightly ringed, pointed at the summits and then slightly tumid, colour a pale cinnabar-red; eyes small, jet-black, situated on tubercles, which are on the head, and joined to the outer base of the tentacula. The foot is greyish white, the sole pale, the muzzle a pale reddish buff-colour.

The operculum, which is carried centrally on the hinder part of the foot, about midway between the shell and the tail, is capable of being withdrawn beyond the internal opening of the sutural tube, although ordinarily closing the aperture.

There is no organ to be seen corresponding with the internal sutural tube, the animal in this respect exhibiting a similarity to that of *Pterocyclos*, which, as described by me in 1836, possesses no soft parts calculated to fill the anomalous portions of the shell near the aperture.

Operculum very thin, horny, concave externally, consisting of $6\frac{1}{2}$ concave volutions with a varnished surface.

For the single living specimen of this shell I am indebted to Capt. R. H. Sankey, by whom it was taken in January. It remained closed in its shell until the 27th of June, when it began to yield slowly to the means employed to revive it, finally moving about and creeping freely under an inverted glass.

Pupina artata, B.

Foot oblong, the sole being somewhat truncate in front and slightly angled at each side anteriorly, hinder extremity narrowed and pointed; muzzle declivous, entire; tentacula short, subulate, and swollen all round at the base; eyes black and prominent, situated on the hinder and external part of the basal swelling.

The operculum is rather thick, horny, rounded at the thickened edge, and consists of $4\frac{1}{2}$–5 concave whorls divided by a raised edge. The inner surface has the umbonal region a little elevated.

In my first description of the shell I stated that the operculum was calcareous, with few whorls. Dr. Pfeiffer, who had the specimen before him, made no alteration in the description, but observed that my characters were abnormal. The paucity of whorls was intended to be comparative with reference to the allied genus *Megalomastoma*. On taking out the operculum of that specimen, its substance appears evidently to be horny; but neither in this species, nor in the Khasia *P. imbricifera*, which

has a still thicker horny operculum, with a very prominent umbo internally, can it be said to answer Pfeiffer's generic description of "membranaceous."

The animal was easily revived in two specimens with the operculum received from Capt. Haughton, and began at once to move about freely and fearlessly. No organ corresponding with the slits at the upper or lower part of the aperture can be detected.

Otopoma clausum, Sow.

A description of the animal, with its singular double sole, has been given in the paper on *Hybocystis*. The operculum is normal. It may be observed that, unlike *Hybocystis*, *Pupina*, and *Rhaphaulus*, the eyes are situated on the side of the tentacula, as it were on the upper end of a short pedicle, soldered to and forming one with the tentaculum, much in the same manner as in the genus *Paludina*.

It is also worthy of remark that, by holding *Rhaphaulus Chrysalis* and *Otopoma clausum* for a few minutes in the hand, and thereby imparting warmth to the animals, they were induced to come out and exhibit themselves. The latter shell had been shut up for a year, and had left Kattiwár eighteen months previously. During several days it had scarcely ventured to do more than raise the operculum, so as to expose a portion of the foot. *Rhaphaulus* was so timid, that on being stirred, or even examined through a lens, it shut itself up, but came out boldly when held for a short time between the fingers, and, on being set down, commenced creeping about. The absence of sufficient warmth has apparently much to do with the shyness observable in some cases.

Helix Achatina, Gray.

Five specimens, taken near Moulmein by Capt. R. H. Sankey, in January, were found to be living.

The sole is oblong, rounded at each end, and pallid. The head, neck, and tentacula are blackish; the upper pair of tentacula long and slender towards the ocular points, the lower ones very short. There is no mucous pore near the hinder extremity.

The animal, as remarked in a previous paper, is probably ovoviviparous, two young and active specimens, with 3½ whorls, having been produced, one of them four, the other seven days after the parents had been revived.

Helix pylaïca, B.

Three living specimens, taken by Capt. Sankey, were examined. The foot is long and narrow (20 millimetres by 2); the upper

tentacula long, and blackish like the back of the neck; the lower tentacula short.

There is a raised, tubercular, mucous? pore above and near the extremity of the foot, not lengthened and overhanging as in *Nanina*? (*Macrochlamys*, B., 1832) *vitrinoides*. A black excrementitious-looking matter is generally found in the orifice of the pore. The animal is active, and not easily alarmed. The narrow form of the foot bears the necessary relation to the curious linear aperture of the shell. Have the North American forms of *Tridopsis* the mucous pore and a similarly narrow foot?

It will be interesting to know, also, whether the Cingalese forms associated with *Helix Achatina* under *Ophiogyra*, Pfr., such as *H. Rivolii*, &c., are ovoviviparous.

Cheltenham, July 4th, 1859.

X.—*Descriptions of four new Species of Humming-birds from Mexico.* By John Gould, Esq., F.R.S. &c.

To the Editors of the Annals and Magazine of Natural History.

20 Broad Street, Golden Square, W.,
July 13, 1859.

Gentlemen,

I send you herewith, for insertion in the next Number of your Magazine, descriptions of four new species of Mexican Humming-birds, for the first of which I am indebted to the researches of M. Rafael Montes d'Oca, and for the three others to M. Adolphe Boucar, through the kindness of M. Sallé.

I am, Gentlemen,
Your very obedient Servant,
John Gould.

Amazilia Ocai.

Crown, sides of the head, throat, and breast glittering grass-green, with a few of the white bases of the feathers showing on the centre of the throat; back of the neck and upper part of the back deep green; upper and under wing-coverts, flanks, lower part of the back, upper tail-coverts and tail greenish bronze; under surface of the base of outer tail-feathers reddish buff; wings purplish brown; base of the secondaries reddish buff; abdomen pale brown; under tail-coverts light bronze margined with white; bill black, lighter beneath; feet brown.

Total length 4 inches; bill $\frac{7}{8}$; wing $2\frac{1}{4}$; tail $1\frac{3}{8}$.

Habitat. Xalapa, in Southern Mexico.

Remark. This species cannot be confounded with any other

member of the genus *Amazilia*; it is about the size of *A. Rieffer*i, and has a splendid glittering green crown. I have named this bird in honour of M. Rafael Montes d'Oca, who has exerted himself to make us acquainted with the productions of Southern Mexico, perhaps to a greater extent than any other person.

Calothorax pulchra.

Male. Throat-gorget fine deep metallic lilaceous purple; head, upper surface, wing-coverts, and flanks green; wings purplish brown; tail brownish black; breast and centre of the abdomen white; bill black; feet dark brown.

Total length $2\frac{1}{4}$ inches; bill $\frac{7}{8}$; wing $1\frac{3}{8}$; tail $1\frac{3}{16}$.

Female. Head dull greyish brown; upper surface bronzy green; throat and under surface buff; wings purplish brown; two centre tail-feathers green, the next on each side green tipped with black, the remainder rusty red at the base and white at the tip, the intervening space being black.

Habitat. Oaxaca, in Western Mexico.

Remark. Allied to *C. cyanopogon*, but differs in the much smaller size of the gorget and in the greater breadth of the outer tail-feathers.

Cyanomyia violiceps.

Male. Crown of the head deep violet-blue; all the upper surface and wing-coverts olive-green; wings purplish brown; tail deep greenish bronze; all the under surface white; bill black; under mandible rather lighter; feet blackish brown.

Total length $4\frac{1}{8}$ inches; bill 1; wing $2\frac{1}{4}$; tail $1\frac{3}{8}$.

Female or *young.* Crown ashy brown; upper surface olive-green, each feather margined with greyish olive; tail-coverts and tail coppery bronze, tipped with greyish olive; under surface white, stained with rusty red on the flanks.

Habitat. Oaxaca, in Western Mexico.

Remark. This is a very distinct species, about the size of *C. quadricolor*, from which it differs in having a black bill and in its violet-coloured crown.

Cyanomyia? sordida.

Male. Head and under surface greyish brown; behind the eye a white spot; all the upper surface and the sides of the neck bronzy green; wings purplish brown; tail dark greenish bronze, approaching to black on the base of the under surface; under tail-coverts very pale brown, with lighter edges; the bill

appears to have been flesh-colour for ⅞ths of its base, and dark at the tip.

Total length 4⅛ inches; bill 1; wing 2¼; tail 1⅝.

Female. Similar, but paler in colour.

Habitat. Oaxaca, in Western Mexico.

Remark. Although I have but little doubt that I have assigned this bird to its natural place, it is with some degree of hesitation that I have included it in the genus *Cyanomyia*: its sordid, smoky-grey style of colouring renders it very distinct from every other.

XI.—*On* Dracunculus *and Microscopic* Filaridæ *in the Island of Bombay*. By H. J. Carter, Esq., Bombay.

[Concluded from p. 44.]

Observations.—Those who have given their attention to the subject cannot fail to see that these worms belong to Ehrenberg's *Anguillula*, out of which Dujardin has formed his genus *Rhabditis*, which is closely allied to our microscopic Filaridæ, as the following characters of this genus will show:—

"Body filiform, narrowed at the ends; mouth terminal, round, naked; anus subterminal; tail of the male either naked or furnished with a membrane (winged); a double spiculum; tail of the female conical, acute. The mouth is succeeded by an oblong cavity (pharynx), which is furnished with two or three longitudinal bacilla, and is distinct from the œsophagus, which is muscular and fusiform or cylindrical; stomach top-shaped or spherical, furnished with a kind of dental armature. The tail of the female is frequently prolonged into a fine point. The uterus is bifid, and the vulva situated near the posterior third of the body*."

Descriptive, however, as this is of the worms to which we have been giving our attention, yet it will not suit them in all respects. Some have papillæ about the mouth, others have tentacula or cirrhi attached to the head, and others have neither. The mouth in some is simple and suctorial, while in others it is armed with an exsertile proboscis, which appears to be but a continuation of the œsophagus; others, again, have eyes; and probably many other differences will present themselves on a more extended examination of their species, which promise to be as numerous as all those of the Nematoid Entozoa put together, if we assume that the latter are derived from the former. Hence it is desirable not to begin to group until many more of

* Micrograph. Dict., Griffith and Henfrey, p. 34.

them have become known; and therefore the generic name of "*Urolabes**," which I have employed, should only be viewed as provisional. It has been chosen from the striking habit which all these worms have of attaching themselves to some object by the tail, whether it be by embracing it or by adhering to its surface. Hence the tail would appear to be both prehensile and adhesive, if not suctorial. Having once fixed themselves in this way, they keep up an undulating movement from the tail forwards, which, in the absence of any evident purpose, seems more for respiration than anything else. They can also, when once attached to any soft substance, hold on until they wriggle themselves into its interior, either for concealment or in search of food; and this peculiarity is not more striking in the microscopic Filaridæ than it is in the young *Filaria Medinensis*.

Their especial habitat is more in the midst of the gelatinous Algæ, *Oscillatoria*, *Glœocapsa*, &c., than in any other place, where they not only meet with gelatine, starch, and oil for food, but frequently with a nitrogenous product in the shape of protoplasm, which is liberated from the decomposition of the vegetable cells with which such Algæ are generally associated; and they abound in such matter not only in the fresh- and salt-water accumulations about the island of Bombay, but everywhere during the "rains;" so that probably there are many which only come into life and breed, like some of the Naïdina, during this part of the year.

The males and females may be generally found together where the species is plentiful; but this is frequently not the case, which, together with their microscopic size and constant motion under examination, or while they retain the least life, renders them very difficult to study, and requires an amount of time which very few have at their disposal to bestow upon them. Hence I have thought it better not to withhold the descriptions of those which follow *Urolabes palustris* because they are not equally detailed, but to offer them for publication so far as they go, that they may be completed by others, and thus the time that has already been spent upon them not altogether lost.

A knowledge of the external parts and the whole of the alimentary canal is easily obtained; and the anus and vulva have been assumed to be ventral in all, from analogy, as there is no other means, from their roundness and minuteness, of determining this in any other way: but many individuals are required before the form of the generative organs can be figured correctly, as these have to be pressed out before they can be seen; and, under such rough treatment, it is only one here and there

* From οὐρὰ, *cauda*, and λάβω, *prehendo*.

that affords a part of these organs distinctly, and none of them the whole at once.

In some instances, where the vulva is placed very far back, the generative organs can hardly be assumed to be symmetrical, as there is no room for an equal development of the posterior half.

In some, again, the ova undergo segmentation to such an extent before being laid, that the young worm is perfectly formed; but I have met with no instances in which it has left the egg while in the interior, so as to make the species viviparous; while in other species segmentation does not commence until the ovum has been discharged, as in *Urolabes palustris.*

Where I have had an opportunity of tracing the development of the embryo, as in *Urolabes erythrops*, the yelk has undergone the common duplicative subdivision already well known to take place in the ovum of *Ascaris*,—the divisions being widely separated at first, and then gradually becoming more approximated as the segmentation increases, until the whole is again brought together, as in the first instance, and the formation of the new being is commenced.

The breeding-season of *Urolabes palustris* appears to commence in January or February, and is all over by the beginning of May; at least, in this month, and during the "rains," I have never met with any females with eggs in them. That of the salt-water species also appears to be chiefly in the spring; while that of the species which only appear during the "rains" is of course confined to this period.

Among the generic characters given by Dujardin to *Rhabditis*, the narrow rigid tube, which appears to me to be the œsophagus, is not mentioned, and the muscular sheath which I have described is viewed alone as the œsophagus. Now, as before stated, the former appears to me to be the œsophagus, for this reason, that in *Urolabes palustris*, which is typical of all the rest in this respect, I have seen oil-globules (the food) come out of the pointed extremity of the œsophagus after its exsertion under pressure, while no food ever appears outside this or in the muscular sheath, and the narrow tube which is continued backwards from the sharp point is the only part which is in continuation with the intestine (Pl. II. fig. 11 *h*, &c.). Again, if the "top-shaped stomach" of Dujardin be that globular portion which appears just about the union of the intestine with the œsophagus in *Ascaris vermicularis*, called also by Blanchard "ventricle or stomach*," such a portion does not exist in *all* the Filaridæ that I have figured; and where it does, the constriction which forms this globular dilatation is in the sheath of the intestine

* Ann. des Sc. nat. t. xi. pl. 7. fig. 3 *d* (1849).

(which latter may be seen passing through it), and has nothing to do with the calibre of the alimentary canal (figs. 29, 30). It is at this point that the œsophagus joins the intestine, after which the latter continues of the same diameter throughout the body, or until it meets the rectum. Not having Dujardin's 'Histoire d'Helminthes,' nor indeed any of the standard works on the subject, I state this with much diffidence, and can only vouch for the truth of what I have seen myself in this respect, and which will be found delineated in the illustrations. It is not improbable that the first part of the intestine may be a little larger than the rest; but, if so, the difference is so slight that it could only be appreciated if the whole canal were seen at once, which it cannot be, as the magnifying power which is required to bring the intestine into view will only admit a small portion of the worm into the field at the same time.

Formerly I stated that in the microscopic Filaridæ the hepatic oil-globules were secreted, in part at least, by the peritoneal lining of the muscular coat; but latterly I have found that there is a distinct peritoneal membrane over those which surround the intestine, thus cutting them off entirely from the peritoneal cavity. It is to this membrane that I have applied the term of "intestinal sheath;" and so firmly are the globules held between it and the intestine, that, even after the whole is forced out of the body by pressure, the oil-globules do not escape until the intestine and its sheath are torn across, when they gradually flow forth from between the two individually, and not enclosed in cells, as those round the intestine of the Naïdina, which are so easily pressed off into the peritoneal cavity, that there does not appear to be any membrane at all between them and this cavity in these worms. When, however, we go to the posterior portion of the intestine in *Urolabes palustris* (fig. 11 *m*), which is uncovered by the hepatic layer (or, at least, where the oil-globules are very scantily present), there they are no doubt grouped in cells, as they are seen in the Naïdina, and, what is more, leave the intestine under pressure, and move off into the peritoneal cavity. What becomes of the lines of oil-globules on the peritoneal surface of the muscular coat, I have not been able to determine,—that is, whether they have any connexion with the hepatic layer, or are merely fatty accumulations.

Dujardin also applies the term "bifid uterus" to the female organs of generation; but as there is no placenta, I prefer the term oviduct or fallopian tube for the lower parts, and so on upwards, as described under *Urolabes palustris*. No doubt the uterus and the fallopian tube here are in one, and the ovary and ovisac also; but while it is desirable to apply the term "ovary" to the whole in the higher animals, it is equally desirable not

to make any division of the oviduct in the lower ones, but to call it after that part to which it comes nearest in the higher animals, viz. the "fallopian tube."

These worms, again, are too small to present any traces of a vascular or nervous system,—at least I have not been able to detect either in *Urolabes palustris*; nor have I been able to ascertain how their respiratory functions are performed, beyond the rhythmical influx and expulsion of water observed to take place in the posterior uncovered part of the intestine (fig. 11 *m*), through the anal orifice and rectum, as before stated. That this takes place in the Naïdina, and is produced there by the cilia which cover the posterior part of the intestine, I have, since my paper on the "Spermatology of *Nais fusca*" was published*, been able to determine. In trying to account for the direction in which the cilia lining the tube of the "segmental organ" carried its contents, I observed that as these (viz. the fæcal contents in the posterior part of the intestine in the same *Nais*) passed towards the anus, and thus against the direction of the cilia, so the direction of the cilia being outwards, or in the opposite direction, in the "segmental organ" should indicate an inward current through this organ,—that is, that the force of the cilia was opposite to their apparent movement†. But since then, I have, by placing some indigo in the water with another species of *Nais*, observed that it was taken into the rectum and some way up it, where it kept oscillating between the peristaltic motion of the intestine and the cilia, until some fæcal matter arrived, when, by a forcible movement of the former, the whole was expelled, and the indigo began to pass in again as before. Thus the current of these cilia was satisfactorily proved to be in the direction in which the cilia appeared to move; and the direction of the movement of the cilia of the segmental organ being outwards, would indicate an outward current in this organ. I mention this more particularly to clear up the difficulty I then had in speculating upon the probable function of the segmental organ. Now in *Urolabes palustris* there is nothing approaching to a contracting vesicle or "segmental organ" in any part of the body, and no evidence of water-respiration beyond that which I have stated. That an aërating function of this kind is performed by the posterior part of the alimentary canal of the Naïdina, is proved not only by what I have stated to occur in the *Nais* on which the experiment of the indigo was made, and by the existence of cilia on the posterior part of the intestine of *Nais fusca*, but by the fact that in another species, like, if not the same with *Nais digitata*, Gmel.‡, which is common in Bom-

* Annals, vol. xix. p. 20. † *Id.* vol. xix. p. 28.

‡ Encyclop. Méth. t. i. pl. 53. figs. 12–18.

bay, the mucous membrane of the rectum is prolapsed as it were into an expanded floral or digitated form, which is covered with cilia in constant and active motion.

Comparison of Filaria Medinensis *with* Urolabes palustris.

On comparing *Filaria Medinensis* with *Urolabes palustris,* it must now be evident that they both belong to the same family, if not to the same genus.

Thus, externally the form is the same,—that is, both are equal in size for a long extent, and then diminish towards the extremities*. The mouth and anus are the same as regards position. There are two evident papillæ on the head in each; but with the mouth they do not bear the same proportion to the body in both, for reasons which will be more evident by-and-by. There is no vaginal orifice or vulva in *Filaria Medinensis,* while there is one in *Urolabes.* Lastly, the tail is curled up and abortive, compared with the development of the body in the adult of *F. Medinensis,*—though the opposite is the case with its young one, where it is more like that of *Urolabes palustris,* and especially that of the young of this species.

In both, the integument is transparent, tough, apparently structureless, and lined by a muscular layer, which presents a number of oil-globules on its surface and a patch of sarcoid glanduliform prolongations in the vicinity of each extremity. In *U. palustris,* however, it is not corrugated or striated transversely, nor is it evidently so in the adult *F. Medinensis.*

The alimentary canal is the same—that is, it consists in each of a narrow œsophagus followed by a much wider intestine, which pursues a straight course through the body, except where it is displaced by the generative organs, to end in a short narrow rectum; but it differs in the rectum being without evident anal orifice, if there be any at all in *Filaria Medinensis.* Again, in both, the œsophagus and intestine are surrounded by their proper peritoneal sheaths, defined by a constriction opposite their point of union, while the former is also surrounded by a muscular sheath, and the intestine by the hepatic organ up to within a short distance of the rectum; the latter is seen more distinctly in the young *F. Medinensis* (figs. 6 *f* and 7 *f* & *c*).

Lastly, the organs of generation are cylindrical and double in each—that is to say, the ovisac with its terminal ovarian tubes, in *Filaria Medinensis,* by being symmetrical, would form

* This diminution is much more abrupt in the illustrations than it is naturally; this is merely in consequence of using a ruler instead of the hand alone for the outline, that this might have no irregularities. The diminution always commences a little behind the union of the œsophagus and intestine, and a little in advance of the anus for each end respectively.

two parallel halves if cut in two in the centre; but at the same time, the ovisac being continuous, uniform in size, and without constriction or projection throughout (fig. 2), besides extending with the ovarian tubes from one end of the body to the other, the whole differs very considerably from the organs of generation of *Urolabes palustris,* which only occupy the middle half, are inflected upon themselves, present a line of demarcation between the ovary and ovisac and the fallopian tube, and a constriction in the latter where it unites with its fellow to form the vagina (fig. 8).

Such are the identities and differences between *Filaria Medinensis* and *Urolabes palustris.* We have now to consider how far the latter are real, or the result of the circumstances under which *Filaria Medinensis* is developed,—that is, compelled to receive support from the surrounding tissues of that part of the human body in which it may be situated, and to retain the whole of its progeny until they are all equally and sufficiently developed for delivery.

Undoubtedly the shrunken state of the alimentary canal throughout, together with the insignificant development of the parts about the mouth, to which I have already alluded, and the apparent obliteration of the anus in the adult *Filaria Medinensis,* compared with the enormous development of the tegumentary and muscular systems, and that of the organs of generation, indicate that the former has not only not kept pace with the latter, but that it has hardly been called into action at all for the development of the organs of generation, &c.; and this is further confirmed by the fact that the head of the adult *Filaria,* always projecting first and perishing, obliterates the mouth, and thus leaves the rest of the body to be nourished and kept alive (which it is, with all the remaining part of the progeny, up to the last inch) through its surface, which nourishment must come from the tissues of the body, and still further by the presence of delicate filaments of cellular tissue adherent to the body of those worms which are extracted by surgical operation before they have begun to protrude of themselves. For the same reason, viz. the want of use, probably arises the diminutive and inflected state of the tail, fixed also to the body by an adventitious membrane; while the instinctive power which presides over the development of the body generally, knowing that a vaginal orifice for impregnation and the exit of the ova would not be required, seems to have arrested the form of the organs of generation at that point where they consisted merely of a cylindrical sac with ovaries, though it allowed the increase in size of these to go on up to that degree which would be sufficient to accommodate the whole of the progeny.

Hence the differences between *Filaria Medinensis* and *Urolabes palustris* do not appear to be real, but modifications of the former to meet the circumstances under which its development takes place; and this appears still more evident when we compare the young *F. Medinensis* with *Urolabes*; for here the former, although without the organs of generation, still has the elongated straight tail and a fully-developed alimentary canal,—so that *it* at once is so far a *Urolabes*. There are no papillæ observable on the head at this period, neither is there a spear-pointed extremity to the œsophagus; but it must be remembered that the characteristic features of the head and tail are only developed with maturity in the microscopic Filaridæ, and when young, they are all more or less alike. The young *F. Medinensis* has, however, perhaps a larger tail proportionally than the young of *Urolabes*, and is corrugated transversely, while it is as large as many specimens of the latter which have arrived at maturity: hence comes the question, whether the young *F. Medinensis* be not a monster form? and then, whether it be capable of existing after it has left the parent?—points which lead to the consideration of the mode in which *Filaria Medinensis* is propagated.

Propagation.—The propagation of *Filaria Medinensis* involves many questions: viz., is this effected by the young ones, or has the worm an external origin? and if the latter, under what form is it introduced into the human body, and whether through the skin or through the alimentary canal? Lastly, is impregnation necessary? and, if so, where does this take place?

To arrive at some conclusion respecting the propagation of *Filaria Medinensis* by its young ones, it was evident that the first object should be to ascertain if the young were capable of maintaining an independent existence; and for this purpose I took some from a healthy full-grown individual, two or three hours after extraction, when they were strong, active, and apparently without impairment of vitality; and having placed a few (for it does not do to take many, on account of the numbers which die soon rendering the water putrid), with some water, in three small saucers, each of which contained a little fine clay at the bottom (which, for fixation, had been allowed to dry there previously), I set them aside for observation under a glass case, close to the window of my room. Furthermore, in one of the saucers were placed a few bits of *Nostoc*, which had been soaked in water to gelatinize them; to a second, a little bunch of *Conferva glomerata*, about as large as an almond, was added; and the third saucer contained nothing but the clay. In this way the water remained fresh in each saucer, while the *Nostoc* afforded a kind of nidus and nutriment, and the *Conferva* and the clay

places of concealment. But after watching these young Guinea-worms for several days, none, according to the best of my remembrance (for I have mislaid the record of the experiments), lived beyond the tenth day; at all events, they all died off so quickly, that it led me to the inference that, if they survived so short a time under such apparently favourable circumstances, they could not be expected to live much longer, if even so long, when they might happen to get into a pool of fresh water, with equally unimpaired vitality,—an occurrence, again, which could only take place during the bathing of a person possessing an extruded *Dracunculus*, since the delicate, soft state of a young Guinea-worm on leaving the parent is such that its death would be inevitable in a few moments, if not liberated under water.

On another occasion, a little solution of glue was added to some young Guinea-worms which, with equal care, had been transferred from the parent to a small saucer in which there was a little portion of gelatinized *Nostoc*, but no clay; and here they were all dead by the fifth day.

To this I may add the results of Dr. Forbes's experiments, who gave the young of a Guinea-worm, fresh from a sepoy's leg, to two pups, and on examining one four, and the other twenty-four hours afterwards, found them (the young Guinea-worms) "dead in the mucus of the stomach and duodenum;" not one of them showed the least signs of vitality*. Those he placed in pure well- or tank-water "died generally the fourth, fifth, or sixth day after birth;" while others placed in "impalpable clay, partially covered with water, and exposed to the sun," lived, in one experiment, to the twentieth day, but did not gain "one particle of increase in their size." So that the want of power thus manifested to maintain an independent existence tends to the conclusion that the young Guinea-worm is not a propagative agent of the species.

The next point for consideration is whether *Filaria Medinensis* originates in the human body; and this is at once answered in the negative, if we are right in assuming that its young ones are unpropagative, since the fact of its existence being confined to tropical regions, and Europeans not getting it unless they have been in these regions, proves, if it be not propagated by its young ones, that the embryos from which it is derived must come from some other source, and that, too, extraneous to the human body.

We have now to consider by what course and under what form it is introduced into the body. As regards the former, the fact that multitudes occur in the legs and feet, while its frequency of occurrence in other parts diminishes rapidly with the

* Trans. Med. and Phys. Soc. Bombay, vol. i. p. 221 (1838).

distance of the parts from the legs and feet, in so much that it is comparatively seldom seen above the hips, strongly tends to the conclusion that it gets into the human body through the skin of the lower extremities, and that it is not introduced through the alimentary canal.

Then, as regards the form under which it is introduced, that cannot be in the shape of an ovum if it be not taken in by the mouth, because the ovum has no means of attaching itself to the surface of the body, and the embryo no means of becoming hatched or existing there for more than a few moments if hatched without water, even supposing that by chance it had lodged on and become adherent to any part of the skin. Thus we must infer that it enters the body in the form of an embryo worm.

Assuming, then, that this embryo, of whatever species of *Filaria* it may be, had that prehensile power of the tail which is not only manifested by the whole group of *Urolabes*, but by the young Guinea-worm itself, while the young of these microscopic Filaridæ, when hatched, are not wider in their transverse diameter than a human blood-globule, and the mouths of the sudorific ducts which stud the surface of the body in myriads not only exceed this in size, but contain within them elements of nutrition, it does not seem far-fetched to assume that, under the form of a *Urolabes*, at the period mentioned (that is, shortly after having been hatched), the embryo of *Filaria Medinensis* might find at least a recess in the human body into which it might wriggle itself by means of its tail, and within which it might be kept moist, obtain nourishment, and be perfectly secure from falling out, until prepared to go further. Then, assuming also that its œsophagus was furnished with a sharp exsertile point like that of *Urolabes palustris* (fig. 11 *d*), it might, from the sudorific duct, bore its way into the subcutaneous cellular tissue, where the development of *Filaria Medinensis* for the most part takes place,—or deeper still, and then by its elongation follow a most intricate and tortuous course, before its head arrived at the surface for extrication.

That the embryos of some of the Filaridæ have the power of penetrating into the bodies of animals, has been proved by Siebold* and Lespés†—by the former in the larvæ of Lepidoptera, and by the latter in *Termites*; and I myself saw the one which I have called *Urolabes parasitica* in variable plurality in the peritoneal cavity of a *Nais*, viz. *N. albida*, which I found inhabiting the very *Glœocapsa* which I had collected for the sake of the microscopic Filaridæ of all kinds which always abound in it.

* Ann. des Sc. nat. t. iv. p. 55, &c., 1855.
† Ann. of Nat. Hist. vol. xix. p. 388, 1857.

Thus the comparison of *Filaria Medinensis* with *Urolabes palustris* leads to the inference, at least, that the former is a *Urolabes* modified; that its young are not capable of maintaining an independent existence long enough to become propagative agents; that the embryo of *Filaria Medinensis* must be introduced into the human body from without; that inference is in favour of this taking place through the skin, and not by way of the alimentary canal; that this must take place when the worm is in an embryo state, or after it has been liberated from the egg; that, by the aid of the prehensile tail, and through the narrowness of the body when very young, it might thus get into a sudorific duct; that, while there, it might be kept alive by the moisture and the nutritive elements which the sudorific duct contains; and that, if provided with a sharp-pointed exsertile œsophagus, like that of *Urolabes palustris*, it might from thence bore its way into the subcutaneous cellular tissue; while the fact that the microscopic Filaridæ do penetrate the bodies of animals still further corroborates all these inferences.

It is not my intention here to do more than allude to the facts I brought forward formerly to support this argument, by the coincidence of *Urolabes palustris* occurring in great numbers in a muddy pool of water in which the boys of a small school bathed, accompanied by an extreme prevalence of *Dracunculus* among them, and the almost total absence of *Dracunculus* in another but very large school (in Bombay), in which the bathing water is taken from a deep tank excavated in the trap-rock, whose silty deposit presented no microscopic Filaridæ of any kind*,—because of itself it is inconclusive; but I may mention with advantage, perhaps, prophylactically, that mud, Algæ, and freshwater plants harbour the microscopic Filaridæ; and that those tanks which, like the wells, are kept free from all these accumulations do not contain any of them, for the simple reason that such tanks afford them neither nidus nor nutriment.

Impregnation.—If we infer that the embryo of *Filaria Medinensis* is the young of one of the microscopic Filaridæ, and that it can only enter the body shortly after it is hatched, that is, at the time when it does not much exceed the diameter of the human blood-globule, its organs of generation are then not developed, and it must therefore enter the body unimpregnated. Again, it cannot be supposed to become impregnated after getting into the tissues; for, to infer this, we must assume an amount of instinct and facility of communication, to enable the male and female to come together under such circumstances, as would be absurd; while we must also assume that all the

* Trans. Med. and Phys. Soc. Bombay, No. 2, new series, p. 45, 1853–54.

males perish, for a male Guinea-worm here is unheard of; and from whence the one figured by Prof. Owen came is not mentioned.

Mr. Lubbock's observations*, however, show that the female organs of generation may throw off buds at one time and ova at another; so that *Filaria Medinensis* may not require to be impregnated to bring forth its progeny.

However this may be, *Filaria Medinensis* is viviparous, and all her progeny are of the same size when she puts forth her head from the surface of the body; while *Mermis albicans*, which is closely allied to *Filaria Medinensis*, enters the larvæ of the Lepidoptera as an embryo, and leaves them at full growth, but *before* it has acquired the organs of generation†. The *Filariæ* which I saw in *Nais albida* were all females; and their oviducts were filled with ova in successive stages of development, each of which was provided with its germinal vesicle and nucleus, and none without it; so that while these *Filariæ* thus differed from *Mermis albicans*, they too might nevertheless have been about to leave their host, in some way or other, for impregnation.

If *Filaria Medinensis* be propagated by its young ones, and these enter the human body directly after they leave the parent, they must enter it unimpregnated, for there is no trace of the generative organs to be seen at the time of their birth; while, if they enter it afterwards, they must be born in water (for they would die out of it), and remain there until the organs of generation are developed,—to which, again, their want of power in sustaining life is opposed.

On the other hand, if it be one of the *Urolabes* which becomes *Filaria Medinensis*, and it enters the body after the organs of generation have become developed, this is quite contrary to what takes place with *Mermis albicans* and other free Filaridæ, which enter the bodies of the animals or insects which they infest in their embryo state, and leave them before the organs of generation are developed. But supposing that one of the *Urolabes* which I have described entered in a mature state, the smallest would have to bore directly through the skin; for it is twice the diameter of the mouth of one of the sudorific ducts, estimating the latter at the 1200th part of an inch in diameter,—and if *Urolabes palustris*, this is three times the diameter at least. It is true that there may be still other species of *Urolabes* which are much smaller, and in their mature state do not exceed the diameter of the orifices of the sudorific ducts; but even then it must be remembered that they have to take in with them a sufficient number of spermatozoa to impregnate the whole of

* "On the Hybernating Eggs of *Daphnia*," Phil. Trans. 1857.
† Ann. des Sc. nat. t. iv. p. 58, 1855.

their ova; and when we consider the size of the spermatophorous cells of *Urolabes palustris*, the number of ova which the female must throw off during a season, the number of spermatozoa required for their impregnation, and the small space afforded by the oviducts for the temporary reception of the spermatozoa, we must infer that, in their free state, there must be several sexual connexions during the breeding-season: for the oviducts of a *Urolabes* like *U. palustris* would not contain a sufficient number of spermatozoa to impregnate a progeny equal to that of *Filaria Medinensis*, which, as before stated, amounts to upwards of a million; while, if there were a *Urolabes* possessing oviducts of sufficient capacity for this, such a one could not, when fully impregnated, pass in through the mouth of a sudorific duct, and therefore must bore its way directly through the skin.

Lastly, we have to assume that, if the female does go in impregnated, a complete change of her organs of generation must take place, and the vaginal orifice become obliterated; while, if the progeny of *Filaria Medinensis* are derived from buds, nothing of the kind need occur, and the worm might pass into the body as *Mermis albicans*, &c., viz. in the embryo state. But such assumptions unfortunately only lead us to the fact that we have not sufficient data to come to a positive conclusion either one way or the other, and that we probably shall remain ignorant of the process of generation until we become acquainted with the origin of *Dracunculus*, which therefore still remains a *desideratum*.

As regards the time which *Filaria Medinensis* takes to pass from its embryo into its full-grown state, nothing is determined. Cases of *Dracunculus*, or the appearance of the worm under protrusion, take place throughout the year; but their maximum is towards the end of the dry weather and the beginning of the "rains," viz. in the months of May and July, and their minimum in January. The "register" of the Native General Hospital in Bombay gives, for the seven years ending 1858, the maximum (viz. sixty-three cases) in August, and the minimum (viz. twelve cases) in February; but there were forty-four cases in May. This, however, is not so useful here as the following result from the town of Sattara, which is about 100 miles from Bombay, because the latter is obtained from soldiers, who of course go into hospital the moment they are sick, while those who go into the Native General Hospital of Bombay, depending for subsistence on their daily work, do not go into it except when driven to it by the severity of the case. Thus, Dr. Murray shows that, from regiments in the cantonment and town of Sattara, for the six years ending 1847, Guinea-worm chiefly

prevailed in "the months of March, April, May, and June, the cases which occurred in these four months constituting three-fourths of the entire number throughout the year." The maximum was in May, viz. 125, and in June, 102 cases; and the minimum in January, viz. 11 cases, after which there is a rapid increase to May; so that it is towards the end of the dry weather and beginning of the "rains"—that is, towards the end of spring and the beginning of summer—that *Dracunculus* is most prevalent.

How this can be brought to bear upon the time required for the full development of *Filaria Medinensis* I am unable to state. According to my observations, *Urolabes palustris* ceases to lay by the beginning of May, and commences to breed as early as January: after May, and on to August, all the females that I have met with, although robust, have presented a shrunken state of the generative organs, and have been without ova. If, then, we assume that all the other species follow this type, and that it is a *Urolabes* which passes into the human body and becomes transformed into *Filaria Medinensis*, then the time required for the development of the latter would be very short. But then there are a number of species, perhaps, which only come into active life and breed during the "rains"—at least, I have never met with them at any other period; and if it be one of these, either in an embryonic or full-grown state, which enters the body, then the time for their development into *F. Medinensis*, as they can only enter during the "rains," must be at least ten months; while there are well-authenticated cases where sailors have gone to England from Bombay, and on returning to it after about a year, have had *Dracunculus* just before they arrived at Bombay: but these cases, unless it could be shown that the individual had had no contact with water from a tropical region from the time he left it until his return, prove nothing.

Lastly, some localities are more productive of *Dracunculus* than others, and the country or the suburbs of a town more than the town itself. Thus, in the least-populated part of the island of Bombay, where the Artillery were formerly cantoned, *Dracunculus* prevailed so much, both among the men and officers, that the place had to be abandoned, and the Artillery brought back to barracks in the town,—an occurrence which, if *Filaria Medinensis* arise from one of the *Urolabes*, seems to derive explanation from the fact to which I have before alluded, viz. that the microscopic Filaridæ abound most in water where there is an abundance of Algæ and aquatic plants, and that this is more likely to be the case about uncultivated ground, and in tanks formed chiefly out of natural depressions in the soil, than in a town where there is neither one nor the other.

As regards the origin of *F. Medinensis* from *Urolabes palustris*, there can be no doubt (as the reader may satisfy himself by the illustrations) that there is an intimate resemblance between the two; to which it may be added, that *Urolabes palustris* is by far the most generally and numerously spread of all the free microscopic Filaridæ in the island of Bombay that have come under my observation; but then the transverse striæ, which are so prominently marked in the young Guinea-worm, are altogether absent in *Urolabes palustris*, while they are present in some of the others that I have described. What the value of this difference may be, I am unable to state; and it is true that in the adult *F. Medinensis* they are so faint that they can only be seen under a tolerably high microscopic power, when they appear to be the transverse fibres of the muscular, rather than rugæ of the tegumentary coat, which they clearly are in the young Guinea-worm; so that, after all, this difference between *Urolabes palustris* and *F. Medinensis* may not be much.

Thus the origin, which is the key to the history, of *Dracunculus* is still unknown, and therefore remains a subject for future and interesting inquiry, but not more so than the still further elucidation of the Filaridæ generally, both free and parasitic; for when we consider that the former abound in species, and are spread in myriads probably all over the world where there is vegetable matter for them to feed upon, in salt as well as in fresh water, in the sea and on the land, while the latter inhabit all animals, perhaps, more or less, down to the lowest worms,—that many of the former leave their habitat and vegetable food for a temporary residence in animals, to live thus on animal food, and that therefore the whole of the parasitic forms may be originally derived from the free ones,—that they not only enter animals, but live and dwell also in plants, as the Paste-worm in the wheat, and *Anguillulina Dipsaci* in *Dipsacus Fullonum**,—that a variable plurality may be peculiarly parasitic on each animal, especially among the higher orders, there being fourteen Nematoidea, of which the Filaridæ are a family, in man alone,—that some of them enter the bodies of animals as embryos, and when sufficiently stored with nutriment, leave their hosts solely for the purpose of generation,—that others, as *Dracunculus*, appear to go into the body already impregnated, and remain there until their whole progeny are ready for delivery before they make their exit,—that the muscles, the innermost parts of the body, the eye, the heart, and the blood itself, are sometimes their abode, and that in many instances their presence is still unaccounted for,—these worms, at first apparently insignificant, from their simple thread-like form and scarcity, are seen to assume

* Gervais et Van Beneden, 'Zoologie Médicale,' vol. ii. p. 101.

an importance in organic creation which calls for a much more extended study of them than they have as yet received.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. *Filaria Medinensis*, outline of, average size of, in Bombay: *a*, head; *b, b*, body; *c*, tail. The papillæ of the head can only be just seen with a lens of 1½-inch focus, and the tail is but just visible to the unaided eye; so these parts are of course not represented in this figure.

Fig. 2. Ditto, generative organs of, natural size: *a, a*, ovaries; *b, b*, ovisac.

Fig. 3. Ditto, alimentary canal of, natural size: *a*, the œsophagus, extending as far as the cross line; *b, b*, intestine; *c*, rectum.

Fig. 4. Ditto, mouth and appendages greatly but proportionally magnified: *a*, mouth (punctiform), in the centre of a circular papilla; *b*, bordered quadrangular space surrounding mouth; *c, c*, large papillæ, situated vertically (?); *d, d*, rudimentary papillæ with other armature, faintly marked, and situated laterally (?).

Fig. 5. Ditto, greatly magnified view of these portions of: *a*, anterior portion; *b*, papillæ; *c*, œsophagus, enlarged towards the mouth; *d*, muscular sheath; *e*, peritoneal sheath; *f*, portion opposite union of œsophagus and intestine; *g*, point of their union; *h*, intestine; *i*, hepatic organ covered by the peritoneal sheath; *k*, posterior portion, showing—*l*, continuation of intestine; *m*, hepatic organ; *n*, rectum; *o*, adventitious membrane binding the tail to the surface of the body.

Fig. 6. Ditto, young of, 1-33rd of an inch long, corrugated transversely: *a*, œsophagus; *b*, muscular sheath of ditto; *c*, junction of œsophagus and intestine; *d*, intestine; *e*, hepatic organ terminating some distance from the end of the intestine; *f*, portion of intestine covered by peritoneal sheath *only*; *g*, rectum and anus; *h*, gland opposite rectum. No papillæ can be seen on the mouth with the highest magnifying power at this period.

Plate II.

Fig. 7. *Urolabes palustris*, n. sp., female, 1-6th of an inch long, drawn on the scale of 1-48th to 1-1880th of an inch: *a*, œsophagus; *b*, muscular sheath of ditto; *c*, point of union of œsophagus and intestine; *d*, intestine; *e*, hepatic organ covered by peritoneal sheath; *f*, portion of intestine uncovered by hepatic organ; *g*, rectum and anus; *h*, vulva; *i, i*, generative organs; *k, k*, contracted forms of the tail approaching that of *Filaria Medinensis*.

Fig. 8. Ditto, organs of generation of, more magnified: *a*, ovary; *b*, ovisac; *c*, cæcal end of ditto; *d*, fallopian tube or oviduct, constricted and dilated alternately, to afford pouches for retaining the spermatozoa; *e*, ovum after impregnation; *f*, vulva.

Fig. 9. Ditto, male, a little shorter than the female, drawn upon the same scale: *a, a*, organs of generation; *b*, penis.

Fig. 10. Ditto, ditto, organs of generation of, more magnified: *a, a*, testicular or spermatic sacs; *b*, contracted portions of ditto; *c*, seminal duct; *d*, penis.

Fig. 11. Ditto, ditto, anterior and posterior portions of, greatly magnified: *a*, anterior portion; *b*, papillæ; *c*, pointed end of œsophagus;

d, buccal dilatation of œsophagus; *e*, œsophagus; *f*, muscular sheath of ditto; *g*, peritoneal sheath of ditto reflected on to intestinal sheath; *h*, point of union of œsophagus and intestine; *i*, intestine; *k*, hepatic organ covered by intestinal sheath; *l*, posterior portion; *m*, posterior end of intestine, uncovered by hepatic organ, but presenting on its surface scattered groups of vesicles, apparently in cells like the biliary cells covering the intestine of the Naidina; *n*, rectum; *o*, anus; *p*, seminal duct; *q*, penis, exsertile at the anus; *r*, muscles connected with the penis.

Fig. 12. Horny elements of the penis separate, showing their scaphoid form.

Fig. 13. Half the female organs of generation, proportionally magnified (scale about 1-12th to 1-5400th of an inch): *a*, ovary, containing the ova in their first stage of development, that is, consisting of a cell-wall lined with transparent endoplasm, bearing in one part the nucleus, which afterwards becomes the germinal spot and vesicle; *b*, ova more advanced, each occupying an entire segment of the ovisac, the endoplasm becoming opake by the development of the yelk-granules; *c*, unimpregnated ovum ready to pass into the oviduct; *d*, cæcal end of the ovisac, containing the granular matter supposed to be the remains of the spermatophorous cells after the spermatozoa have left them to penetrate the ovum; *e*, oviduct; *f*, point of junction of, with the ovisac; *g*, *i*, dilated portion filled with spermatophorous cells and their included spermatozoa; *h*, constricted portion of oviduct; *i*, truncated portion of ditto; *k*, a few of the spermatophorous cells separate; *l*, impregnated ovum, now without the germinal vesicle, but surrounded by an additional coat, viz. the shell or chorion, ready for segmentation.

Fig. 14. Half the male organs of generation, greatly magnified: *a*, testis, or end of the spermatic sac, which throws off from its surface the spermatic cells, each of which here consists of a cell-wall lined with transparent endoplasm bearing in one part the nucleus; *b*, portion of the spermatic sac where the endoplasm has developed granules or nuclei, which become the spermatophorous or daughter cells; *c*, portion where the nuclei have become elongated and their proper cells become evident, while they have also assumed a radiated arrangement; *d*, last portion, where the nuclei, now transformed into spermatozoa, but still within the daughter cells, have left the parent; *e*, constricted portion of spermatic sac going to form with its fellow (*f*) the seminal duct; *g*, seminal duct, truncated; *h*, spermatophorous cells.

N.B. The following figures, which are delineated after nature, have all been drawn on the same scale, viz. 1-12th to 1-5400th of an inch, in order that their relative proportions might be preserved for the purpose of illustrating the development of the spermatozoa.

Fig. 15. Spermatic cells increasing from a mere point to the full size of their first stage, which consists of a cell-wall lined with endoplasm and bearing in one part a nucleus: this corresponds with part *a*, fig. 13.

Fig. 16. Shows the first appearance and gradual increase in size of the nuclear points and daughter cells in the endoplasm of the spermatic cell, from which the spermatozoa are ultimately developed.

Fig. 17. Nuclear points and daughter cells in a more advanced state, showing that there are spermatic cells of different sizes, and with a variable number of nuclear points in them.

Fig. 18. Ditto, ditto, in a still more advanced state, where the daughter cells surrounding the nuclear points have become apparent. The last three figures illustrate the granular state of the cells seen at *b*, fig. 13.

Fig. 19. Spermatic cells of different sizes, after the spermatozoa have become nearly developed and nothing but a few fragments of the endoplasm remain: *a*, spermatic cell containing only one daughter cell, and therefore yielding only one spermatozoon (had there been no cell round the spermatozoon, then this cell must have been taken for a daughter cell); *b*, ditto containing two daughter cells; *c*, containing four; *d*, containing twelve, and *e*, upwards of twenty. Each spermatozoon must have been surrounded by a daughter cell; but as these were only seen in *a* and *b*, they are only inserted there, it being my object here particularly to represent the figures of this series as they appeared to me. *f*,*f*,*f*, unemployed or refuse fragments of the endoplasm—that is, those parts which have not gone to the nourishment of the daughter cells; and the like is seen in the daughter cells themselves, being the residue of their contents which have not entered into the formation of the spermatozoa; *g* shows a peripheral arrangement of the elongated nuclei and, of course, the daughter cells, though the latter did not come into view here. It is this peripheral arrangement which I cannot reconcile with the radiated one, but which I am inclined to think may arise from dislocation of the group of cells during their forcible expulsion.

Fig. 20. Group of daughter cells with their contained spermatozoa arranged in the radiated form (seen at *c*, fig. 14), but here without the parent cell: *a*, group of eight, arranged in a radiated form here, within the parent cell.

Fig. 21. Spermatic cells with the daughter cells and their contained spermatozoa leaving them: *a*, *b*, ditto, showing the way in which the parent cell is pushed before the daughter cell into a conical form; *c*, daughter cells still adhering to the parent cell. Fig. 14 *h* and fig. 13 *k* show the state of the daughter cells containing the spermatozoa after they have left the parent cells, as they fill the large end of the testicular sac and dilatations of the oviduct respectively.

Fig. 22. Spermatozoa struggling to get out of their cells, illustrative of those in the upper part of the oviduct especially, and also of many in the large end of the testicular sac. See also here the unemployed fragment of endoplasm to which I have already alluded.

Fig. 23. Daughter cells, illustrative of the development of the spermatozoon, in which the latter is seen to be formed from the nuclear point, which further appears to pass into the head first, as it becomes elongated: *a*, daughter cell containing endoplasm and nuclear point; *b*, nucleus elongated; *c*, nucleus transformed into spermatozoon, and all the endoplasm, with the exception of the fragment already mentioned, absorbed (direct view); *d*, lateral view of ditto. The tail is too minute and transparent here to be seen; but in the cells of the foregoing group, though still invisible, its effect upon the form of the daughter cell is obvious.

Fig. 24. Spermatozoon of *Urolabes palustris*, normal form, 1-600th of an inch long.

PLATE III.

Fig. 25. *Urolabes Glœocapsarum*, n. sp., female, 1-54th of an inch long: *a*, anterior portion; *b*, caudal portion; *c*, *c*, buccal dilatation and œsophagus; *d*, muscular sheath of the latter; *e*, point of union of œsophagus with intestine; *f*, intestine; *g*, hepatic organ; *h*, rectum; *i*, anus. The male is the same as the female, with the exception of the tail being a little shorter, and the addition of the penis.

Fig. 26. *Urolabes labiata*, n. sp., female, 1-40th of an inch long: *a*, anterior portion, the head bearing two papillæ; *b*, caudal portion; *c*, apparatus apparently connected with the exsertion and retraction of the œsophagus (seen also in figs. 25 and 27). The other parts having been indicated in fig. 25, will not require repetition.

Fig. 27. *Urolabes tentaculata*, n. sp., female, 1-23rd of an inch long: *a*, anterior portion, the head bearing two tentaculiform prolongations; *b*, caudal portion.

Fig. 28. *Urolabes cirrata*, n. sp., female, 1-73rd of an inch long: *a*, anterior portion, the head bearing two short linear cirrhi; *b*, posterior extremity.

Fig. 29. *Urolabes erythrops*, n. sp. (marine), female, 1-20th of an inch long: *a*, anterior portion; *b*, caudal portion; *c*, peritoneal sheath of œsophagus; *d*, globular dilatation and double post-œsophageal constriction of the peritoneal sheath, partly lined with the hepatic organ; *e*, ocelli; *f*, caudal portion of male; *g*, penis.

Fig. 30. *Urolabes infrequens*, n. sp. (marine), female (a little larger and longer than the foregoing): *a*, anterior portion; *b*, caudal portion; *c*, peritoneal sheath of œsophagus; *d*, post-œsophageal globular form of the peritoneal sheath; *e*, ocelli (?); *f*, caudal end of male; *g*, penis; *h*, gland.

Fig. 31. *Urolabes ocellata*, n. sp. (marine), female, 1-23rd of an inch long: *a*, anterior portion, the head bearing four cirrhi; *b*, caudal portion; *c*, ocelli; *d*, caudal end of male; *e*, penis.

Fig. 32. *Urolabes barbata*, n. sp. (marine), female, 1-7th of an inch long: *a*, anterior portion, the head bearing four cirrhi; *b*, caudal portion; *c*, pointed, apparently exsertile end of œsophagus in buccal dilatation; *d*, ocelli; *e*, caudal end of male; *f*, penis. The two globular bodies (*d*), in this as well as in fig. 30, although in situation and appearance exactly like those of figs. 29 and 31, are colourless, or only yellowish; and therefore I can only infer that they are ophthalmic organs.

XII.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By ANDREW MURRAY, Edinburgh.

[Continued from vol. iii. p. 30.]

Feronidæ.

ANAULAX, mihi.

(From ἄνευ and αὖλαξ, in allusion to the absence of the scutellar accessory stria on the elytra.)

Facies et forma ut in *Amara*. Caput mediocre; oculi haud prominentes. Clypeus distinctus, brevis. Labrum transver-

sum, quadratum, integrum. Mandibulæ et maxillæ mediocres. Palpi tenues, cum articulis ultimis cylindrico-ovalibus. Mentum profunde excavatum et emarginatum, emarginatione sine dente medio, sed leviter sinuato. Ligula membranacea, sat grandis, cum paraglossis annexis, projicientibus ut cornubus leviter clavatis. Antennæ breves, capite et thorace breviores, articulis longitudine fere æqualibus, secundo excepto (sed haud multo) breviore; primis tribus lævibus, cæteris pubescentibus et parum dilatatis. Prothorax convexus, postice latior. Elytra thorace haud latiora, ad ejus basin conniventes, striata, sed sine stria suturali accessoria. Pedes mediocres; tibiæ anticæ dilatatæ et intus fortiter emarginatæ; tarsi tenues, triangulares, setis subtus utrinque instructi.

1. *A. iridescens*, mihi.

Niger, iridescens, nitidissimus; thorace fovea basali longitudinali lævissima utrinque instructo; elytris punctato-striatis; antennis, palpis pedibusque ferrugineis.
Long. $4\frac{1}{2}$ lin., lat. 2 lin.

Black, very polished and shining, and beautifully iridescent when looked at from before backwards with its head to the light; the iridescence rich, and with a proportion of green, yellow, and coppery red, besides blue, in it. The form is that of an *Amara*. Head impunctate; labrum, antennæ, mandibles, and parts of the mouth ferruginous. Thorax subquadrate, narrowest in front, with the anterior angles bent down; posterior angles translucent, slightly acute, with the points rounded; sides edged; an elongate triangular space within the posterior angles flattish, the remainder of the surface convex; no dorsal line; a short slender basal fovea or line containing a single row of four or five minute punctures on each side of the space opposite the scutellum. Scutellum ferruginous, smooth. Elytra truncate at the base, oval and emarginate towards the apex, pretty deeply punctate-striate, the intervals impunctate, convex; the striæ converge towards the apex and become deeper, and the interstices more convex: as already said, there is no accessory sutural stria; there are a few deep punctures on the exterior interstice. Under side more or less piceous and iridescent, impunctate. Legs testaceo-ferruginous.

I have only received one specimen of this new species. At first sight, one would take it for an *Amara*; but I am not aware of any *Amaræ* having been hitherto found further south in Africa than the Mediterranean district: besides, it is iridescent, which is also opposed to its being placed among the *Amaræ*; and on further examination, we find other differences. It has no tooth

to the mentum, which *Amara* has; it has its paraglossæ soldered to, or rather forming part of, the ligula, which is a character that, according to Lacordaire, should remove it not only from *Amara*, but from the *Feronidæ* altogether, and carry it into the *Pseudoferonidæ*. The dilatation of the anterior tibiæ, however, and the want of squamules under the tarsi, prevent us placing it with them. But there is another character which it possesses in common with a small group of the *Feronidæ* (a group with which, however, it has no other connexion), viz. the want of an accessory sutural stria,—a thing which, except in these few instances, does not occur among the *Geodephaga*. I have unfortunately only received a female, or at all events an individual which has not the anterior tarsi dilated; so that the essential characters founded on the dilatation of the tarsi of the male are unknown to me. On the whole, however, from its facies and other affinities, I would place it among the *Feronidæ*, in a position apart, but not far from the *Amaræ*.

Anchomenidæ.

Anchomenus, Bon.

1. *A. angulaticollis*, mihi.

Elongatus, angustatus, niger; thorace angulato antice postice et lateribus, postice valde coarctato et exciso, ad basin vix capite latiore; elytris ovatis, marginatis, depressis, ad suturam parum elevatis, punctato-striatis, interstitiis sparsim distincte punctatis; antennis fuscis, ad basin ferrugineis, femoribus pallide testaceis, geniculis tibiis tarsisque piceis.
Long. 5½ lin., lat. 2 lin.

Elongate, narrow, black. Head smooth, shining, and impunctate, with a well-marked elongate impression on each side in front at the base of the antennæ; labrum large, quadrate; mandibles, maxillæ, mentum, and palpi piceous. Antennæ fuscous; three basal joints shining ferruginous, slightly flattened, rather thicker in the middle than at either extremity. Thorax somewhat hexagonal, in front a little wider than the ne[illegible] the base scarcely wider; the anterior margin slightly emarginate; anterior angles obtuse, slightly rounded; the lateral margin with its anterior half extending backwards and outwards nearly in a straight line to about the middle, when it turns in, forming an obtuse angle, the extremity of which is slightly rounded; it then continues obliquely inwards, making a deep excision on the posterior part of the thorax; towards the base it bends in, becoming for a short space straight, and then turning slightly outward, so that the posterior angles are rather sharper than

right angles: the base is truncate, slightly obtuse towards the angles; the lateral margin is piceous and semitransparent, deeply and broadly reflexed, and the sides edged (most so behind), forming a deep channel, which is transversely rugose; the rugosities extend along the base, more faintly in front, and still more so across the disk, which is convex and almost free from punctures; the dorsal line is deep, merging in the curvilinear impression in front, which is also well marked. Scutellum impunctate, but finely rugose. Elytra elongate-ovate, truncate at the base, emarginate and sinuate at the apex; rather depressed, but slightly raised at the suture; the lateral margins reflexed, most deeply so behind the shoulders; punctate-striate; the interstices sparsely but somewhat coarsely punctate, the marginal space with pitted impressions. Under side piceous, polished and shining, more or less rugosely punctate on the mesosternal and metasternal parapleura; faint traces of punctures on the prosternal parapleura. Thighs pale testaceous; knees, tibiæ, and tarsi piceous.

A. planaticollis, mihi.

Depressus, latus, supra niger, subtus piceus; thorace lato, fere plano, hexagono; elytris punctato-striatis, interstitiis impunctatis; pedibus pallide testaceis.

Long. 6 lin., lat. 2½ lin.

Broad, depressed, black or dark piceous. Head smooth, shining, and impunctate, with an elongated impression on each side at the base of the antennæ, and traces of one or two small punctures or impressions behind these; labrum piceous, quadrate; mandibles, maxillæ, mentum, palpi, and basal joints of antennæ piceous; remainder of antennæ fuscous, and rather thicker in the middle than at the extremities. Thorax depressed, broad, nearly hexagonal in shape, but broader than long; emarginate in front; all the angles nearly equally obtuse, and all rounded off, anterior most so: the lateral margin angled nearly in the middle, the anterior half nearly straight, the posterior slightly emarginate and waved: base obtuse towards the angles, slightly emarginate in the centre: the sides are semitranslucent and very broadly and shallowly reflexed, and nearly, though not quite, as much so in front as behind; the broad channel so formed is well defined and rugosely punctate; the anterior and basal marginal spaces are less deeply so; the disk slightly raised and smooth, but not very convex; the dorsal channel deep, reaching to the base, but not quite to the anterior margin; the sides of the reflexed margin are distinctly edged. Scutellum rugosely punctate. Elytra oblong, very flat and depressed; sides nearly parallel; base truncate, and shoulders

square; apex broadly emarginate, approaching to truncate sides only slightly reflexed: deeply punctate-striate; interstices convex and impunctate; two impressions on the third interstice, one on the exterior side of it about one-fifth from the base, and another on the interior side of it about one-third from the apex; marginal space narrow, increasing in breadth till it reaches the apical emargination, where it is broad, and bears pitted impressions. Under side piceous, polished and shining, rugosely punctate on the mesosternal and metasternal parapleuræ; the prosternal parapleuræ with very faint traces of punctures. Legs pale testaceous; knees slightly darker.

3. *A. patroboides*, mihi.

Præcedenti affinis; niger, thorace interdum subvirescente; thorace subcordato, convexo; elytris punctato-striatis; pedibus testaceis.

Long. 5¼ lin., lat. 2⅛ lin.

Allied to the preceding, but smaller, and not so broad nor so depressed. Black; sometimes with a tinge of virescence in certain lights on the thorax. Head smooth, shining, and impunctate, with a deep fovea on each side in front, and an exterior narrow groove between it and the base of the antennæ; labrum quadrate, smaller than in the preceding species; mandibles and other parts of the mouth and base of the antennæ ferruginous; remainder of antennæ fuscous. Thorax subcordate, widest at the middle, with a slight tendency to the hexagonal form of that of *A. planaticollis*, but with a deeper and narrower reflexed margin; anterior margin emarginate; base truncate, oblique towards the angles, which are obtuse; the reflexed margin is narrow in front and widest at the base, and it, as well as the base, is rather finely rugose or rugoso-punctate: the disk is convex, reminding one of the thorax in *Patrobus*, impunctate; the dorsal line and arched line in front are well marked, the former reaching from the anterior margin to the base. Scutellum impunctate, almost smooth. Elytra as in *A. planaticollis*, except that the striæ are not so deep, the punctures in them less distinct, and the interstices less convex. Under side smooth and impunctate, with the exception of some faint traces of impressions on the parapleuræ or at the sides of the basal segments of the abdomen. Legs testaceous.

Colymbetidæ.

Agabus, Leach.

1. *A. hydroporoides*, mihi.

Elongatus, oblongo-ovalis, parum depressus, nitidus, impuncta-

tus, supra brunneus, infra rufo-ferrugineus; capite toto læte ferrugineo; thorace late ad latera (interdum fere toto) pedibusque ferrugineis; elytris ad basin anguste et macula oblonga apicali ferrugineis.

Long. 2½ lin., lat. 1¼ lin.

Elongate, oblong-oval, rounded in front and behind, depressed, shining. Head entirely clear ferruginous, smooth, and without impressions. Antennæ and palpi testaceous. Thorax brown, with broad ferruginous margins encroaching on the disk (or perhaps it may be more accurate to say—thorax ferruginous, with the anterior and posterior margins, especially towards the middle, becoming embrowned); it is rather more than twice as broad as long, broadly emarginate in front, cut nearly straight behind, being only slightly bisinuate, broader behind than in front; very slightly rounded on the sides, which have an extremely slender edging: the anterior angles projecting, and rounded at the point; posterior angles nearly right-angled: a narrow, very finely punctate impression runs along and parallel to the anterior margin, and a short, curved, similarly punctate impression lies parallel to the base on each side of the middle, commencing nearly opposite to the exterior of the scutellum. Scutellum short, broad, and ferruginous. Elytra long, depressed, brown, with a narrow ferruginous transverse band along their base, and an elongate curved ferruginous patch lying parallel to the exterior margin at the apex; they have three scarcely perceptible, interrupted, longitudinal lines of points lying more to the exterior than the suture, the middle line most interrupted, being reduced to an occasional point: the reflexed portion of the elytra at the base ferruginous. Under side ferruginous, shining, and impunctate. Legs paler, especially the four anterior.

This is, I think, the first instance of an *Agabus* having been recorded as found in Africa south of the Mediterranean district. The present species has very much the form and size of *Hydroporus memnonius*; but the five-jointed tarsi, the presence of a scutellum, and the unstriated elytra readily indicate its true position.

Gyrinidæ.

Gyretes, Brullé.

1. *G. nudivittis*, mihi.

Oblongo-rhomboideo-ovalis, dorso convexo; capite nitido æneo, lateribus subtus oculos pubescentia æneo-sericea vestitis; thorace disco nitido æneo, limbo testaceo reflexo translucente marginato, lateribus pubescentia æneo-sericea vestitis; elytris

similiter pubescentia vėstitis, vitta ænea curta nitida dorso ad basin utrinque indutis, limbo testaceo reflexo translucente marginatis; elytris apice paulo oblique truncatis, angulis externis spinulosis; subtus testaceus.

Long. 5 lin., lat. 2½ lin.

Somewhat rhomboidally oblong-oval, convex on the back, broadest and highest about the middle. Head polished shining brassy, with a scarcely observable minute tubercle on each side close to the inner margin of the eye; along the sides under the eyes clothed with a thick, rich silky, brassy pubescence; labrum projecting, and thickly covered with projecting long hairs. Antennæ dark piceous. Thorax deeply emarginate in front and much bisinuate behind; much narrower in front than behind; sides almost straight, and having the margin reflexed, so as to form a rather broad flat ledge, which is testaceous and translucent, the posterior angles of which, when looked at from above, seem obliquely truncate; above this ledge a broad band of thick, silky, brassy pubescence extends up the steep sides of the thorax; the disk of the thorax, which is flattish and of the same proportions as the entire thorax, shining polished brassy, its surface seeming to project slightly beyond the pubescent part, the separation between the two being here, as in every other part of the insect, well defined; the anterior margin has a narrow edging, the posterior none; there is a transverse depression or hollow band, unmarked by punctures or impressions, running across the shining disk rather behind the middle. No scutellum. Elytra clothed like the thorax with a brassy pubescence, and having a similar testaceous ledge running round the margin, which terminates as an acute, not very prominent tooth or spine: on each side of the back there is a narrow bright brassy line, which appears to be raised above the surrounding pubescence; it starts from the base at a point corresponding to the exterior margin of the shining disk of the thorax, and proceeds parallel to the margin of the elytra for nearly but not quite half the length of the elytra, at first slightly increasing in breadth, and then gradually tapering to a point; it is not much broader than the marginal ledge: the apex of the elytra is obliquely truncate, and there may be a sutural apical spine; but my specimen is injured at that point, and I cannot say whether there is such a spine or not. Under side and legs testaceous; the last segment of the abdomen very conical and narrow.

This species is interesting as being the first instance which has been recorded of the genus *Gyretes* being found in the Old World, all those previously described having come from America.

Hydrobiidæ.

PHILHYDRUS, Sol.

(Subgen. *Helochares*, Muls.)

1. *P. longipalpis*, mihi.

Oblongo-ovalis, latior pone medium, leviter convexus, brunneus vel testaceo-brunneus, valde nitidus, levissime dense punctatus; clypeo bilobato; palpis maxillarum longissimis, caput cum thorace longitudine fere æquantibus; thorace in angulis anticis semicirculari impressione levissime punctata instructo; elytris sine stria suturali, sed punctorum duabus seriebus levissimis; subtus lividus vel pallide brunneus, pubescens; pedibus concoloribus, femoribus pubescentibus.

Long. $3\frac{1}{2}$–$3\frac{3}{4}$ lin., lat. $1\frac{3}{4}$ lin.

Oblong-oval, broadest behind the middle, gently convex, brown, livid or testaceous brown, very shining and smooth, pretty densely punctate, but so faintly that the punctuation is not perceptible except under a good lens. Head rather darker and more coarsely punctate than the rest of the body; clypeus bilobed, a row of minute punctures running parallel to the margin of the lobes; labrum, palpi, and other parts of the mouth ferruginous; maxillary palpi about as long as the head and thorax taken together; labial palpi short. Thorax with the sides rounded and slightly edged; the anterior angles much rounded, posterior gently rounded; anterior margin slightly emarginate, the base with the angles extending backwards and overlapping the elytra: there is a curved impression in the anterior corner, which may be likened to a letter C, one on each side, facing each other (thus, C Ɔ); more strictly, it may be described as a congeries of faint punctures (deeper than those on the general surface) lying parallel to the margin for the anterior two-thirds of the thorax, turning inwards and downwards at the anterior angle, extending in a curve towards the disk, and terminating at some distance nearly opposite to a similarly curved impression which extends upwards, as if to meet it, from the posterior end of the marginal punctation; the marginal part of this semicircular impression is not so deep as the two incurved wings. Scutellum elongate. Elytra without any sutural stria, but with two faint though tolerably distinct rows of punctures, the exterior one near the margin, and the interior one about halfway between the suture and the margin, but rather nearer the latter; the elytra have a slight disposition to turn up at the margin. Under side same colour as above, but rather paler, pubescent. Legs, with the thighs, pubescent; posterior knees not pubescent.

[To be continued.]

XIII.—*Descriptions of new Genera and Species of Phytophagous Insects.* By J. S. Baly, Esq.

[Concluded from p. 61.]

Fam. Eumolpidæ.

Genus Lamprosphærus.

Caput fere perpendiculare, in thoracem ad dimidiam partem oculorum insertum; *oculis* oblongo-ovatis, introrsum obsolete sinuatis; *antennis* gracilibus, subfiliformibus, ad apicem leniter incrassatis, articulo primo incrassato, secundo hoc dimidio breviore, ovato, duobus proximis filiformibus, longitudine fere æqualibus; *palpis maxillaribus* articulo ultimo ovato, apice obtuso. *Thorax* transversus, convexus, interdum elytrorum latitudini æqualis, apice concavus. *Elytra* breviter ovata, convexa. *Pedes* graciles; *tarsis posticis* articulo primo elongato-trigono, duobus sequentibus longitudine fere æquali, secundo trigonato, antice subemarginato, tertio illo latiore, fere ad basin diviso, *unguiculis* dente obtuso armatis. *Prosternum* longitudine paullo angustius, lateribus medio in dentem indistinctum productis; *mesosternum* subquadratum, apice obsolete angulatum. *Corpus* subhemisphæricum, valde convexum.

Type, *Lamprosphærus abdominalis*, Baly.

Lamprosphærus tarsatus.

L. subglobosus, nitido-niger, subtus viridi-cæruleus; antennis basi tarsisque fulvis; elytris seriatim punctatis.—Long. 2½ lin.

Hab. Cayenne.

Lamprosphærus abdominalis.

L. subglobosus, dorso obsolete gibbosus, nitido-cæruleus; corpore subtus antennisque nigro-piceis; unguiculis, antennarum basi abdomineque rufo-fulvis; capite, thorace elytrorumque margine æneo-micantibus; thorace elytris vix angustiore, tenuiter subremote punctato, elytris subseriatim punctatis; femoribus posticis simplicibus.—Long. 2½ lin.

Hab. Amazons.

Lamprosphærus collaris.

L. ovato-rotundatus, valde convexus, nitido-niger, fronte thoraceque flavis, hoc limbo angusto maculaque transversa apicali plerumque lineas tres retrorsum ad basin emittente nigro-piceis; antennis (his extrorsum fuscis), facie inferiore, pedibus quatuor anticis, tibiis posticis tarsisque fulvis; elytris thoracis latitudini vix æqualibus, postice paullo angustatis, distincte seriatim punctatis; femoribus posticis simplicibus, tarsis anticis 4 (*maris*) dilatatis. —Long. 2 lin.

Hab. Upper Amazons.

Lamprosphærus specularis.

L. subhemisphæricus, valde convexus, dorso obsolete gibbosus, metallico-olivaceus, subopacus; ore, antennis (harum articulo septimo ultimique apice fuscis), abdomine pedibusque flavis; elytris tenuiter seriatim punctatis, plumbeis, dorso antico spatio communi nitido-nigro-cæruleo; tarsis 4 anticis articulo basali dilatato, ovato-rotundato, femoribus posticis subtus obsolete unidentatis.—Long. 2 lin.

Hab. Amazons.

Lamprosphærus æruginosus.

L. subglobosus, dorso obsolete gibbosus, niger, nitidus, antennis (his apice fuscis), abdominis margine pedibusque fulvis; supra obscure viridi-cæruleus, capite, thoracis apice lateribusque elytrorumque margine æneis; thorace crebre punctato; elytris apice extremo rufo-fulvis, seriatim punctatis, interstitiis elevatis; femoribus posticis subtus unidentatis.—Long. 1¾ lin.

Hab. Amazons.

Genus CHRYSOCHUS, Redtenb.

Chrysochus Chinensis.

C. oblongo-elongatus, convexus, nitido-cæruleus, antennis nigris, articulis oblongo-obovatis; thorace subgloboso, subremote punctato; elytris irregulariter, ad suturam confuse subseriatim, punctatis.

Var. A. minor. Obscure cæruleus aut nigro-cæruleus.—Long. 6, var. 4–5 lin.

Hab. Northern China.

Nearly allied to the European species, *C. pretiosus*; but the average size of the typical form is much greater, being intermediate between that insect and *C. Asiaticus*: in the present species the thorax is more globose and less closely punctured; the elytra are also differently punctured, and the joints of the antennæ longer.

Chrysochus thoracicus.

C. oblongo-ovatus, valde convexus, nitido-cæruleo-niger, oculorum orbitis, pleuris scutelloque viridi-cyaneis; pedibus obsolete æneo-micantibus; fronte thoraceque subremote punctatis, nitido-cupreis, illo medio longitudinaliter canaliculato, hoc subgloboso; elytris subseriatim punctatis.—Long. 3½ lin.

Hab. Northern China.

Genus CORYNODES, Hope.

Corynodes gloriosus.

C. oblongus, convexus, nitido-purpureus; thorace irregulariter hic illic fortiter punctato; elytris crebre punctatis, aureo- aut viridi-æneis, plaga humerali apiceque purpureis.—Long. 5–6 lin.

Hab. Northern India.

Genus Chrysolampra, Baly.

Caput fere perpendiculare, ad marginem posticum oculorum insertum; *oculis* anguste ovatis, intra obsolete sinuatis; *antennis* gracilibus, filiformibus, corporis longitudini fere æqualibus; articulo primo incrassato, secundo brevi, duobus proximis æqualibus, quarto paullo longiore, cæteris huic et inter se fere æqualibus; *palpis maxillaribus* clavatis, articulo ultimo ovato. *Thorax* transversus, convexus, angulis anticis declivibus. *Elytra* oblongo-ovata, convexa. *Pedes* modice robusti, *femoribus anticis* incrassatis, subtus dente acuto armatis; *tarsis posticis* articulo primo duobus sequentibus æquali, a basi ad apicem ampliato, secundo trigonato, tertio hoc paullo latiore, fere ad basin diviso; *unguiculis* dente compresso armatis. *Prosternum* basi longitudine vix angustius, lateribus concavis. *Corpus* oblongum, convexum.

Type, *Chrysolampra splendens*, Baly.

Chrysolampra splendens.

C. oblongo-elongata, viridi-ænea, auro resplendens, ore antennisque nigris, labro fulvo; thorace remote punctato; elytris irregulariter, prope suturam subseriatim, punctatis, punctis ad latera fortiter impressis, interstitiis elevatis.—Long. 4–5 lin.

Hab. Northern China.

Genus Dermoxanthus.

Caput perpendiculare, thorace ad oculorum marginem insertum; *oculis* ovatis, intra leniter sinuatis; *antennis* corporis dimidio longioribus, gracilibus, ad apicem paullo incrassatis et compressis, articulo primo incrassato, obovato, secundo brevi, oblongo (cæteris elongatis), tribus proximis filiformibus, tertio quintoque æqualibus, quarto paullo breviore, reliquis perparum leniter compressis et incrassatis, ultimo ovato; *mandibulis* magnis, curvatis; *palpis maxillaribus* subfiliformibus, articulo ultimo ovato. *Thorax* subcylindricus. *Scutellum* semiovatum. *Elytra* subelongata, convexa. *Pedes* modice robusti, simplices; *tarsis posticis* articulo primo duobus sequentibus conjunctim breviore, subtriangulo, basi angustato, secundo trigonato, tertio hoc latiore, fere ad basin diviso, *unguiculis* appendiculatis. *Prosternum* subtrapeziforme, a basi ad apicem angustatum, lateribus bisinuatis, medio in dentem indistinctum productis; *mesosternum* oblongum, subpentagonum. *Corpus* elongatum, subcylindricum.

Type, *Dermoxanthus fulvus*, Baly.

Dermoxanthus fulvus.

D. elongatus, subcylindricus, nitido-fulvus, antennis extrorsum mandibulisque apice nigris, tarsis piceis; elytris parallelis, utrisque punctorum seriebus 11 impressis, prima abbreviata, punctis in striis confuse gemellato-dispositis, interstitiis ad latera subcostatis.—Long. 5 lin.

Hab. Old Calabar.

Dermoxanthus fraternus.

D. elongatus, subcylindricus, nitido-fulvus, antennis extrorsum nigris, pedibus piceis; thoracis latitudine longitudini æquali; elytris ad apicem leniter angustatis, utrisque punctorum seriebus 11 impressis, prima abbreviata, punctis in striis in serie unica inordinatim dispositis.—Long $3\frac{1}{2}$–$4\frac{1}{2}$ lin.

Hab. Old Calabar.

Genus Stenolampra.

Caput perpendiculare, in thoracem ad oculorum marginem insertum; *oculis* ovatis, intra emarginatis; *antennis* filiformibus, corporis longitudini fere æqualibus, articulo primo incrassato, secundo brevi (cæteris gracilibus filiformibus), duobus proximis æqualibus, quarto paullo elongato, reliquis huic et inter se fere æqualibus, ultimo angustato-ovato; *palpis maxillaribus* articulo ultimo ovato, apice conico. *Thorax* subcylindricus, margine laterali multidentatus. *Scutellum* subquadratum, apice obtusum. *Elytra* subelongata, postice vix angustata, convexa. *Pedes* subelongati, *femoribus* leniter incrassatis, *anticis* subtus dente cretæformi armatis; *tarsis posticis* articulo primo angustato, duobus proximis fere æquali, secundo elongato trigonato, apice emarginato, tertio hoc vix latiore, fere ad basin diviso, *unguiculis* basi dentatis. *Prosternum* late subquadratum; *mesosternum* oblongo-trapeziforme, apice obtusum. *Corpus* elongatum, convexum.

Type, *Stenolampra costata*, Baly.

Stenolampra costata.

S. anguste elongata, convexa, subtus nigro-picea, infra ænea, nitida, antennis fulvis, articulis basalibus infuscatis, capite remote punctato, ore nigro-piceo; thorace evidenter subremote punctato, margine laterali tridentato; elytris basi thorace latioribus, postice paullo angustatis, convexis, utrisque striis 11 punctorum impressis, prima abbreviata, punctis in striis confuse gemellato-dispositis, interstitiis convexis, elevatis, postice valde costatis, costis paullo ante apicem abrupte abbreviatis; cupreis, anguste æneo-marginatis.

Var. A. Elytris concoloribus.—Long. 4–5 lin.

Hab. Ega, Upper Amazons.

Stenolampra geniculata.

S. elongata, convexa, fulva, nitida, geniculis nigris; thorace remote punctato, lateribus bidentato; elytris anguste oblongis, postice vix angustatis, subseriatim punctatis, vitta submarginali tota interstitiisque nonnullis paullo ante apicem, elevatis; fulvo-brunneis, metallico-cæruleo vix micantibus.—Long. 4 lin.

Hab. Ega, Upper Amazons.

Broader and less elongate than the preceding species.

Genus Typophorus, Erichs.

Typophorus quadripustulatus.

T. ovatus, convexus, nitido-niger, antennarum basi, labro, fronte elytrorumque maculis quatuor rufis; capite rugoso; thorace subremote evidenter, elytris minus regulariter (præsertim ad latera), seriatim punctatis.—Long. $3\frac{1}{2}$ lin.

Hab. —— ?

Typophorus basalis.

T. ovatus, convexus, nitido-cæruleo-niger, antennarum basi fulva; elytris infra basin leniter transversim impressis, regulariter seriatim punctatis, punctis ad apicem obsoletis; parte tertia antica testacea.—Long. 4 lin.

Hab. Brazil.

Typophorus Kirbii.

T. ovatus, convexus, obscure nitido-æneo-niger, antennarum basi fulva; elytris infra basin vix transversim impressis, regulariter seriatim punctatis, punctis ad apicem tenuissimis, utrisque fascia lata basali rufa.—Long. 3 lin.

Hab. Brazil.

Narrower than *T. basalis*; one-half the size; the punctures on the elytra visible to the apex.

Typophorus obliquus.

T. ovatus, convexus, nitido-æneo-niger, antennarum basi fulva; elytris infra basin leniter transversim impressis, regulariter seriatim punctatis, punctis ad apicem obsoletis, utrisque plaga magna basali, a sutura ad marginem lateralem extensa, postice obliqua, rufa.—Long. 3 lin.

Hab. Venezuela.

Typophorus humeralis.

T. ovatus, convexus, nitido-æneo-niger, antennarum basi fulva; elytris infra basin valde transversim impressis, regulariter seriatim punctatis, punctis ad apicem obsoletis, utrisque plaga magna humerali testacea.—Long. $2\frac{1}{2}$ lin.

Hab. Guatemala.

Typophorus ruficollis.

T. ovatus, convexus, nitido-niger, capite, antennarum basi, thorace, scutello, elytrorumque parte tertia antica rufis; elytris infra basin transversim impressis, seriatim punctatis, punctis ad apicem fere obsoletis.—Long. $3\frac{1}{4}$ lin.

Hab. Brazil.

[To be continued.]

XIV.—*On* Diclidanthera. By John Miers, F.R.S., F.L.S. &c.

This genus, established by Prof. Von Martius in 1826, was referred by him to *Styraceæ*, on account of its gamopetalous corolla (its stamens being adnate to it, and double the number of its lobes), its simple style, its 5-celled ovary with pendent ovules, its drupaceous fruit, often by abortion monospermous, and its albuminous seed, enclosing an embryo with a superior radicle.

Prof. Lindley (in 1836), following this indication, in his 'Introduction to Botany,' placed the genus in *Styraceæ*, after *Halesia*.

Owing to the peculiar structure of its anthers, Endlicher (in 1839), in his 'Genera Plantarum,' retained it in the same linear position, but separated it as a distinct section, following *Styraceæ*.

No further notice was taken of it until Prof. A. DeCandolle (in 1844), in his monograph of the last-mentioned order (Prodr. viii. 245), merely alluded to it when he excluded it from that family, on the ground of its free ovary, its anthers fixed in the mouth of the tube of the corolla, its pollen striated transversely, and its minute embryo; but he did not assign it any other position.

Prof. Lindley (in 1846), in his 'Vegetable Kingdom,' arranged it, in the Appendix, among those genera whose precise locality in the system is not ascertained.

In 1852 I offered a few observations*, indicating its probable affinity with *Hamamelidaceæ*; but a more critical examination of the genus has since convinced me that it has a nearer affinity elsewhere.

Prof. Von Martius (in 1856), in his 'Flora Brasiliensis' (fasc. 17. p. 11. pl. 4), extended the recital of its generic features, describing at full length, and figuring with much detail of analysis, the two species he had delineated in his 'Nova Genera et Species' thirty years previously. My own observations, aided by the drawings and analyses made in 1837 upon the living plant, differ in several points of structure from those details, as I will presently show; and upon these facts I will proceed to discuss the question of the true affinity of the genus.

Prof. Von Martius, in his later work, after enumerating the several characters showing its affinity towards *Styraceæ*, expresses his opinion that this relationship rests more on outward appearances than on reality; and he proceeds to state his reasons for suggesting its nearer affinity to *Moutabea* (which genus he illustrates at the same time), and, through it, to *Polygalaceæ*.

* Ann. Nat. Hist. ser. 2. ix. 130; Contrib. to Bot. p. 130.

This affinity does not appear to me evident, for the following reasons:—in *Moutabea*, both calyx and corolla are really tubular, and are confluent together for half their length; the borders of the calyx and corolla are both alike in size, and each divided into five segments of unequal proportions; the stamens are combined into a free tube terminating in a ventricose fleshy hood, cleft on one side, as in *Polygalaceæ*,—points of structure at variance with those of *Diclidanthera*. Again, in *Moutabea* the ovules are attached by their middle to the centre of the axile column; the seed has no albumen, and its embryo has large oblong fleshy cotyledons, with a minute radicle drawn in between them on the side of the shorter axis,—features, again, incompatible with all that is found in *Diclidanthera*.

In this genus, as stated on a former occasion*, although the corolla assumes a tubular form, it is not really gamopetalous; the tube is composed of five narrow linear petals, loosely held in juxtaposition by the simple application and agglutination of the thin membranaceous stamens upon their inner surface. Of this fact we may easily be convinced by moistening a flower, then laying hold, one by one, of each segment of the border and pulling it downwards, when each petal comes away separately, without the laceration of either of its margins. Indeed, Martius, in describing the corolla as being monopetalous, qualifies this by admitting it to be "quasi a petalis 5 secundum marginem leviter coalitis:" but in stating that the free lobes of its border have a quincuncially imbricated æstivation, he has overlooked the fact that the margins of their lower portions, in forming the tube, overlap each other contorsively,—that is to say, if we look from the centre of the flower, the dexter margin of each petal is introrse, while the sinister side is extrorse, and quite free in its entire length, appearing like a keel twisted sideways, and ciliated to the base: they are simply held together, as above mentioned, by the adhesion of the extremely thin monadelphous tube of the stamens; and from the point at which that tube terminates, the remaining upper portions are quite free, constituting what have been termed the segments of the border. The same fact is again shown by laying hold of each anther separately and pulling it downwards, when a corresponding strip of the staminal tube is torn away to the base, and the petals are thus left quite free: this tube is too delicate and membranaceous to be detached in an entire state without laceration; but the structure, by the treatment I have mentioned, is thus rendered manifest. All the parts of the flower are isometrical in number, and symmetrically arranged: five free linear sepals rise from the hemispherical cup of the

* Ann. Nat. Hist. ser. 2. ix. 130; Contrib. to Bot. p. 130.

calyx; five alternate petals spring from the margin of the cupular disk, which is adnate to this cup; and ten anthers in one regular series are disposed on the summit of the adnate tube formed of the confluent filaments, five being alternate and five opposite to the petals, so that they thus appear sessile in the mouth of the seemingly gamopetalous tube of the corolla. The structure of these anthers offers a striking peculiarity: they are reniform, compressed, erect, affixed by their basal sinus upon a very short and broad portion of the filaments, which are conjoined below into a monadelphous adnate tube, as before mentioned: these anthers consist of two collateral cells, united into a compact body; and they open a little obliquely by a lateral fissure, or rather by a hippocrepial line round their margin, into two unequal valves, the posterior retaining its naturally erect position, the anterior valve becoming bent downwards. If we compare this structure with the stamens of *Büttneria*, we perceive a close similarity between them,—the chief difference being that in the latter case the monadelphous tube of the stamens is free from the corolla down to its base, the union of the filaments is there not complete, and the free portions of the filaments appear as so many segments of the border of the tube. Gay, in his monograph of the family of the *Büttneriaceæ*, shows that in *Commersonia Fraseri** five of these stamens are anantherous, much extended, and 3-fid, and five alternately short and antheriferous; its anthers are reniform, like those of *Diclidanthera*, and are fixed by their sinus to the apex of the short broad filament, which is reflexed at its apex, and the stamens appear as if they were extrorse; each anther, in like manner, opens by a hippocrepial line bilabiately, the internal valve remaining pendent, and the more external valve rising into a vertical position, so that the anther thus expanded is peltate, its cells being collaterally placed. If we imagine the monadelphous tube in this case, as well as its free segments, to be agglutinated to the corolla, as in *Diclidanthera*, the anthers would necessarily be erect, instead of reflexed, we should find them placed exactly as in that genus, and their dehiscence would be precisely similar.

The ovary is globular, decidedly stipitate, as in *Büttneria*, and in like manner five-celled, with two ovules, one of them often rudimentary, suspended from the central column below the apex of each cell by a very short funicle; the primine has a wide tubular mouth in its summit, close to the funicle; and the raphe is distinguishable, extending along the ventral side to the base. Although, in the *Büttneriæ*, the ovules are generally numerous in each cell, they are reduced to two, placed collaterally, in *Rulingia*. In the ripe fruit of *Diclidanthera*, each suspended

* Mém. du Mus. x. p. 215. tab. 15. figs. 8, 9, 10, & 11.

seed is oval and compressed: the external tunic, which becomes black in drying, is covered with a white retrorse pubescence: the intermediate tunic is somewhat coriaceous and of a red colour, polished, and free from the outer tunic in the fresh state, but becomes intimately agglutinated to it in drying; it is marked by a distinct hilar scar at its summit when fresh, and by a chalazal areole at its base: the inner integument is white and membranaceous. The embryo is of the breadth, and $\frac{5}{6}$ths of the length of the fleshy albumen by which it is enveloped; the cotyledons are large, nearly orbicular, slightly cordate at their base, thin, foliaceous, veined, and of a greenish colour in the living state; the radicle is short and terete, and nearly touches the summit. This embryo is described and figured by Von Martius as being very minute, in the summit of the albumen: this is certainly an error, originating probably in the seeds examined by him being in an immature state. It should be observed that this structure resembles that of the seeds of *Rulingia*, *Commersonia*, *Abroma*, *Guazuma*, and of all the *Lasiopetaleæ* and *Hermannieæ*.

From these several points of structure, it is evident that *Diclidanthera* bears little relation towards the *Ebenaceæ*, *Styraceæ*, or *Polygalaceæ*, as suggested by botanists; for though it has some features approaching the latter family, it is totally distinct from it in the great symmetry of all its parts and the structure of its stamens. The facts above described show its near affinity to *Büttneriaceæ*, among which family the genus *Philippodendron* presents many points of close analogy to that under consideration: it exhibits in an equal degree perfect symmetry in its parts; the monadelphous tube of the stamens is agglutinated to the corolla; its sessile anthers, double in number to the petals, burst transversely into two valves; a single ovule is suspended from the angle in the summit of each cell of the ovary; it has a simple style and a clavate stigma. The pedicels of the flowers of *Diclidanthera* also have each three very deciduous bracts at their base, and are articulated upon as many glands, as frequently observed in *Büttnerieæ*; and its liguliform petals exhibit the contorsive imbrication of their margins, which is so marked a feature in that family. We may further add to these points of approximation the analogy of its stipules, which offer so marked a feature in that order; they are present in *Diclidanthera*, although very deciduous, and they are accompanied by peculiar persistent glands. From the *Philippodendreæ*, through *Diclidanthera*, there is a more perfect transition-link between *Büttneriaceæ* and *Sterculiaceæ*, especially with the tribe *Myrodieæ*, with which our genus has several characters in common.

The following is an emended character of the genus, based upon my own observations:

Diclidanthera, Mart. Pluchia, *Vell.*—*Flores* hermaphroditi. *Calyx* in imo hemisphæricus et hinc cum *disco* cupuliformi carnoso adnatus, superne in *sepala* 5, linearia, obtusa, æqualia, utrinque pilosa, æstivatione quincuncialiter imbricata, decidua, divisus. *Petala* 5, æqualia, sepalis 2–3-plo longiora et alterna, margine disci enata, et ultra medium ad tubum staminiferum agglutinata, hinc pseudo-gamopetala, marginibus contorsive imbricatis, sinistris connatis, dextris liberis, ciliatis, et carinis totidem obliquis efformantibus, supra tubum omnino libera, apicem versus paullulo latiora, obtusa, subpatentia, æstivatione quincuncialiter imbricata. *Stamina* monadelpha, cum petalis orta, *filamenta* in tubum integrum, cylindricum, elongatum, tenuissime membranaceum, ad petala arcte agglutinatum, 10-nervem, coalita: *antheræ* 10, æquales, uniseriatæ, in marginem tubi filamentorum insertæ, erectæ (et ut videtur in fauce tubi corollæ sessiles), reniformi-ovatæ, 2-loculares, loculis collateralibus sine connectivo coalitis, transversim 2-valves, rima oblique hippocrepica dehiscentes, valva postica paullo majore erecta, antica hiante deflexa et e basi pendula. *Pollen* globosum, vittis 4 notatum, et transversim creberrime lineatum. *Ovarium* parvum, subglobosum, glabrum, stipitatum, obsolete 5-sulcatum, 5-loculare; *ovula* in quoque loculo bina (uno minore et effœto), ad axin centralem infra apicem suspensa, micropylo supero, raphide ventrali. *Stylus* simplex, pilosus, stamina excedens. *Stigma* parvum, clavatum, breviter 5-lobum. *Drupa* globosa, cupula parva calycina suffulta, sicca, coriacea, indehiscens, 5-locularis, 5-sperma, aut abortu 2–3-sperma. *Semen* suspensum, ovatum, compressum; *integumenta* 3, *extimum* fuscum, retrorsum pilosum, pilis albidis, sub lenti rugoso-punctatum, *intermedium* rubellum, nitidum, crassiusculum, vertice hilo notatum, basi chalaza signatum, *intimum* membranaceum. *Embryo* in *albumen* tenue, carnosum, paullo longius inclusus; *cotyledonibus* suborbicularibus, subcordatis, planis, foliaceis, viridiusculis, albumini fere æquilatis, et paullo brevioribus, *radicula* brevi, tereti, supera, summum attingente.

Arbusculæ *Brasilienses intertropicæ,* ligno *duro rigido,* ramis *subsarmentosis,* ramulis *sæpissime pendulis*; folia *petiolata, integerrima, nitida, valde reticulata, glabra, in nervis puberula, glandulis paucis sæpe in dichotomiam nervorum immersis*; petiolus *in imo articulatus*; stipulæ *binæ, acutæ, deciduæ, utrinque e glandula umbilicata ortæ*; inflorescentia *racemosa*; racemi *folio breviores, in ramulis novellis axillaribus terminales, pluriflori*;

flores *alterni breviter pedicellati*; pedicellus *breviusculus, e nodulo 3-tuberculato ortus, in imo articulatus et 3-bracteatus*; bracteæ *parvæ, acutæ, valde deciduæ*; corolla *ochroleuca, siccitate purpurascens*; fructus *cerasiformis*.

1. *Diclidanthera penduliflora*, Mart. Nov. Gen. ii. 140, tab. 196; Flor. Brasil. fasc. xvii. 11, tab. 4. fig. 1;—ramis pendulis, ramulis subpuberulis; foliis oblongis vel lanceolato-oblongis, utrinque acutis, supra lucidis, hinc ad basin petiolum versus 2-glandulosis, costa media inferne rufescente, glabris, utrinque valde reticulatis, petiolo tereti, pubescente; racemis in ramulis novellis terminalibus, folii floriferi fere longitudine; sepalis extus fere glabris, sub lente sparse retrorsum puberulis, corollæ glabræ ochroleucæ tertia parte longitudinis.—Brasilia tropica, ad fluv. Amazonas—*v. s. in herb. meo*,—prope Santarem (Spruce).

Prof. Martius describes it as a tree 10 to 15 feet high, with loose pendulous and subscandent branches, the leaves being 4 to 6 inches long and 12 to 18 lines broad. In Spruce's specimen they measure 4 inches in length, and 15 to 17 lines in breadth, on a petiole 3 lines long. In the size of the tree, its habit, in the form of its leaves, their size and colour, this species is scarcely to be distinguished from the following one, the only valid specific difference being in the two basal glands constantly seen on the *upper* side of the leaf, at the point of junction of its blade with the petiole, which are always wanting in *D. laurifolia*. The corolla is a little more slender and rather longer in regard to the calyx, and when dried, of a brighter crimson colour; its pedicel is only half a line long; the sepals, which become reddish in drying, are 4 lines long and 1 line broad; the length of the corolla is 10 or 11 lines, including the border of 3 lines, the tube being only a line in diameter.

Var. *β. penæantha*, Mart. *loc. cit.* D. Martii, *Pöpp. MSS. in herb.* 2883;—"foliis brevioribus, latioribus, ovato-oblongis, basi subrotundatis, petiolis evidentius puberulis; racemis depauperatis (2–3-floris) petiolo 2-plo longioribus; calycibus evidentius pubentibus."—Fluv. Amazonas, Ega (Pöppig).

This variety I have not seen. In the form of its leaves it seems to approach more to *D. elliptica*; but the presence or absence of the basal glands on the upper surface of the leaves will determine to which species it belongs. The shortness of its racemes, which are only half an inch in length, and its being only two- or three-flowered, if a constant character, would suggest the possibility of its being accompanied by other marked specific differences.

2. *Diclidanthera laurifolia*, Mart. *loc. cit.*;—ramis glabris, subscandentibus; ramulis subpendulis et puberulis; foliis elliptico- vel lanceolato-oblongis, utrinque subacutis, glaberrimis, valde reticulatis, margine cartilagineo rubello reflexo, supra nitidis, basi superne eglandulosis, subtus costa media rubella, sæpe in dichotomia nervorum glandula umbilicata instructis, petiolo tereti, pubescente; racemis in ramulis novellis terminalibus, folio subbrevioribus; sepalis utrinque puberis; corolla subglabra, ochroleuca, sicca purpurascente.—Brasilia, Prov. Rio de Janeiro.—*v. v.* ad Santa Theresa, in ascensu ad Montem Corcovadensem.

A tree about 15 feet high, with a habit quite as subscandent as the preceding species, and with its branchlets half-twining, half-pendulous: its leaves are from 2 to 3 inches long, 12 or 14 lines broad, upon a petiole 3 lines in length; they are hardly distinguishable in form and appearance from the former, and in both species they assume a reddish hue in drying; below they are of a pale green, with a reddish midrib and prominent anastomosing nervures. In this species more particularly, small round glands with an umbilicated centre are often, but not constantly, found immersed in the forked points of the nervures on the under side only of the leaf, and are never seen upon the upper surface as indicated in the preceding species. In both species the stipules are seen on each side of the insertion of the articulated petiole, linear, acute, erect, and half a line long, each springing out of a gland similar to those seen on the under side of the leaf. The racemes, which grow out of the extremities of the younger branchlets, are generally about 1½ inch long, with about eight to ten flowers placed alternately; the pedicel of each flower is a line in length, and proceeds from a prominent nodule formed of three confluent glands, which bear as many deciduous bracts, similar to those which support the stipules. The sepals are 4 lines long, 1 line broad, and retrorsely pubescent on both sides. The corolla is of a yellowish white (not white, as stated), which in drying becomes of a bright red colour: including the portions that form the border, which are 3 lines long and barely a line broad, it measures 9 lines. A singular peculiarity is observable in its æstivation:—the free margin of each petal, where the adherent portions form the tube, is turned in the same direction, showing a contorsive imbrication, while the free portions constituting the border are quincuncially imbricated in the bud. The exsuccous rugose drupe is about 8 lines in diameter, and is of a reddish colour when fresh, becoming fuscous brown when dry, and quite coriaceous, with chartaceous dissepiments. The suspended seeds,

solitary in each cell, are covered with a white and almost woolly pubescence; they are 5 lines long, 3 lines broad, and 2 lines in thickness: the albumen is white and fleshy: the embryo is quite green, the cotyledons being orbicular, 2⅛ lines in diameter; its superior radicle, ¾ of a line long, nearly touches the summit.

3. *Diclidanthera elliptica*, n. sp. Pluchia curiosa?, *Vell. Flor. Flum.* vol. iv. tab. 20, text, p. 157;—foliis ellipticis vel late ovatis, apice subacutis et mucronatis, basi obtusioribus, utrinque pallide viridibus, valde reticulatis et subpuberulis (præsertim in costa media straminea, et in nervibus), margine vix reflexo, superne opacis, omnino eglandulosis, subtus rarius in dichotomiis nervorum glanduliferis, petiolo tenui, pubescente; racemis plurifloris, in ramulis novellis terminalibus, folio interdum longioribus; sepalis utrinque valde pubescentibus, corolla dimidio brevioribus, oblongis, obtusis; corolla fusciore subpuberula, marginibus petalorum in tubum longe ciliatis.—Brasilia.—*v. s. in herb. meo*,—Prov. Minas Geraës (Gardner, 5002); Iguassu, in Prov. Rio de Janeiro (filio meo lecta).

This is certainly a very distinct species, with quite a different aspect from the two former. It has scarcely the same scandent habit; the leaves are larger, broader in proportion, paler, greener more dull on the upper surface when dried, and mucronate at the point; they are 3¾ inches long, 1¾–2 inches broad, on a petiole of 2½ lines; the midrib is of a pale straw-colour; they bear no basal glands on the upper surface, as in *D. penduliflora*, but they have similar glands on the nerval furcations, as in the last species. The racemes are similarly terminal, 1½–2 inches long, 10–15-flowered; the pedicels are 1 line long; the sepals 3 lines; the corolla rarely exceeds 6 lines in total length, the tube being only 4 lines long, broader than in the preceding species, and always of a dark fuscous red when dry, the margins of the limb being somewhat paler. The calyx, as well as the whole branchlet, is more densely pubescent, being almost tomentose. The description given in the text of Velloz of his *Pluchia curiosa* corresponds better with this species than with the preceding one, to which it is referred by Prof. Martius. By Velloz it is placed in Octandria Monogynia: I have found it to happen occasionally, in all the species, that one or two of the anthers are deficient; but in that case the tube of the stamens is constantly 10-nerved*.

* A drawing of this species, together with analytical details of the structure of the flower and seed of *Diclidanthera laurifolia*, will be given in the 'Contributions to Botany,' pl. 32.

XV.—*Notes on the Hydroid Zoophytes.* By Prof. Allman.

I. *Laomedea flexuosa,* Hincks.

In the polypes of *Laomedea flexuosa,* the ectoderm of the tentacles is extended laterally between these organs for a distance of about a fourth of their entire length from their origin, so as to form a web-like membrane, similar to that already pointed out by Mr. Alder in *L. acuminata.*

This peculiarity in a very common zoophyte seems to have been hitherto overlooked, though, in a morphological point of view, it is a character of much importance.

II. *The extra-capsular medusiform sporosacs ("meconidia") of* Laomedea, *and the determination of the species in which they they are found.*

In a communication on the Reproductive Organs of the Hydroid Zoophytes, read last year before the Royal Society of Edinburgh*, I referred to the extra-capsular medusiform sporosacs, so well known from Lovén's description of them in a zoophyte which he names *Campanularia* (*Laomedea*) *geniculata,* and expressed my opinion that Lovén's zoophyte was not truly *Laomedea geniculata,* but *L. flexuosa* of Hincks, a species to which I referred similar bodies which I had myself examined.

Mr. Alder, writing to me since then, suggests the possibility of the species which gives rise to these sporosacs being neither the one nor the other, but a distinct, though not yet discriminated, species.

As we know that both *L. geniculata* and *L. flexuosa* give rise also to a different kind of sexual bud, it will be at once seen that this question has an important physiological significance apart from its bearing upon simple descriptive diagnosis; and I therefore availed myself of the first opportunity to inquire critically into the subject. The result has been a conviction that Mr. Alder's doubts are well-founded.

A few weeks since, I obtained upon the shores of Cramond Island, in the Firth of Forth, a *Laomedea,* growing on the fronds of *Fucus vesiculosus,* and loaded with gonophores, most of which carried upon their summits the peculiar bodies under consideration.

The only described species of *Laomedea* with which it is possible to confound the Cramond zoophyte are *L. flexuosa, L. geniculata,* and *L. dichotoma.* From *L. flexuosa,* however, it differs in the more elongated form of the polype-cells, in the more conical form of the gonophores, and in the absence of the web

* Proc. Roy. Soc. Edinb. 1858.

which, as already mentioned, connects the bases of the tentacles in *L. flexuosa*. From *L. geniculata* it differs not only in its being much branched, but in the form of the gonophores, which in *L. geniculata* are provided with a short tubular orifice, while here they have a broad truncated summit. From *L. dichotoma* it differs in its mode of branching; but it may be more decidedly distinguished by the form of its gonophores, which in *L. dichotoma* open by an elevated tubular orifice, as in *L. geniculata*.

The following diagnosis will serve to give, in a condensed form, the leading characters of the species:—

Laomedea Loveni, nov. sp.

Char.—Stem alternately branched, but at irregular intervals. The ultimate ramuli regularly alternate, given off at nearly equal intervals from a distinct geniculation of the supporting branch, which is annulated for a short distance above the origin of each ramulus. The ultimate ramuli are annulated in their entire length, and are nearly or fully as long as the polype-cells.

Polype-cells deep (a little more than twice as deep as wide), with an even rim.

Gonophores tapering from a broad flat summit to a narrow base, so as to present the form of an inverted cone, seated on short annulated peduncles, which spring from the stem close to the origin of a polypiferous ramulus.

Polypes with from 22 to 30 tentacles, which are not united at their base by a membrane.

Reproduction by fixed sporosacs which ultimately become medusiform and extra-capsular (*meconidia*).

Two distinct forms of this zoophyte must be noticed, which, though very different in general appearance, cannot be specifically distinguished from one another.

Var. α. Forming continuous meadow-like growths upon the surface of sea-weeds, &c., scarcely exceeding one inch in height.

Var. β. In long lax tufts, attaining a height of 3 or 4 inches.

It appears to me that it is the var. α. of this species which was originally described by Lister* under the name of *Campanularia geniculata*, and afterwards by Lovén†, and again by Schultze‡, under the same name, while I have myself § fallen into the error of describing it under the name of *Laomedea flexuosa*. It is also probably the same which Dr. Wright || has described as *Laomedea dichotoma*.

It is possible there may be more than one species of *Laomedea*

* Phil. Trans. 1834.
† Wiegmann's Archiv, 1837.
‡ Müller's Archiv, 1851.
§ Proc. Roy. Soc. Edinb. 1858.
|| Edinb. New Phil. Journ., Jan. 1859.

which give origin to extra-capsular medusiform sporosacs; as yet, however, we have no evidence of any other than that here described. Though Lister is the first author who has spoken of the remarkable bodies in question, having figured male examples of them in the paper referred to, yet it is to Lovén we are indebted for the first accurate and full description of them. I have therefore thought it right to dedicate the present species to the Danish naturalist whose name has already become intimately associated with these medusiform sporosacs, and to designate it as *Laomedea Loveni.*

In the paper above referred to, I mentioned my having failed to detect in the extra-capsular sporosacs, whether male or female, any trace of the radiating canals first described by Lovén. In my more recent examination of these bodies, I was for a long time, notwithstanding the most careful scrutiny, equally unsuccessful; but at last a specimen occurred, with female gonophores, in which the appearance figured by Lovén was not only apparent but strikingly obvious. I am still, however, of opinion that this peculiarity of structure is not constant, many specimens presenting not the slightest trace of it.

The real meaning of these rib-like lines is, after all, a matter not easily settled. They may be proper tubes, the true representatives of the radiating canals of a Medusa; but there seems at least equal reason to consider them as mere folds of a membrane which lies immediately within the ectothecal covering of the sporosac, and I confess myself unable to give a decided opinion on this point. In favour of the former view may be adduced their undoubtedly tube-like appearance, their occurrence in fours, and the fact that their presence would be quite in accordance with what analogy would lead us to expect. On the other hand, against their being gastro-vascular canals may be urged their obliteration under slight pressure, the absence of all trace of motion in their interior, and, above all, their frequent, if not most usual, non-existence.

The opportunities I have just had of examining these extra-capsular sporosacs have enabled me to determine their exact structure more fully than appears to have been yet done. I now find that three separate membranes enter into the composition of their walls. Most internally is a membrane which immediately confines the ova or spermatozoa, and which was originally the ectodermal layer of the manubrium. This investment is generally of short duration, becoming absorbed or ruptured under the increasing volume of the generative products. It is the endotheque, according to the terminology I have already ventured to propose (Proc. Royal Soc. Edin. Dec. 1858). Most externally is a thick ectodermal layer loaded with thread-cells

(the ectotheque); and between these two is a third membrane, which has been hitherto overlooked, and which is the true representative of the umbrella of a Medusa. It is on the summit of this middle sac, or *mesotheque,* as it may be appropriately called, and not on that of the ectotheque, as I formerly believed, that the short tentacles which crown the sporosac originate; they surround an orifice in the mesotheque, and pass out through a corresponding orifice in the ectotheque. The walls of the mesotheque are thickened round the orifice, and here apparently contain a circular canal, as indicated by the presence of coloured granules: if radiating canals really exist, it is in this membrane that they are developed.

The tentacles possess, like the marginal tentacles of a true Medusa, considerable contractility. They may frequently be seen of very different lengths in different sporosacs of the same specimen; and this, which is really the result of different degrees of contraction, may be easily taken for different degrees of development, the tentacles being especially sluggish in the act of extension or contraction. Their length when fully extended, in the female sporosac, will equal about half the diameter of the sporosac, while under external irritation they will slowly contract to a third of their original length, and will then show themselves as a little stellate crown on the summit of the sporosac. They vary in number; I have counted in the female sporosac from 8 to 16 or 20. They are composed of ectoderm and endoderm, the ectoderm containing thread-cells, and the endoderm presenting the usual septate appearance. They are less numerous and less developed in the male than in the female.

That the bodies now described belong to the class of sporosacs rather than Medusæ, must, I think, be admitted. In all essential points they agree with the sporosacs of *Tubularia indivisa,* in which a mesotheque is fully developed*; and it should also be borne in mind that when Medusæ are produced in the *Laomedeæ* and *Campanulariæ* they belong to a different type, the generative products being developed upon the course of the radiating canals, and not, as in these medusiform sporosacs, in the walls of the manubrium.

They are thus of no little interest in the morphology of the zoophytes; and it will be found convenient to speak of them by a special name. Their singular resemblance, especially when their tentacles are contracted, to a poppy-capsule with its sessile stellate stigma, will instantly strike us, and has suggested to me the name of *meconidia*†, by which I propose to designate them.

* See "Notes on Hydroid Zoophytes" in a previous Number of the 'Annals.'

† From μήκων, a poppy.

III. *Coryne eximia*, nov. sp., *and its Medusa.*

Attached to rocks and the stems of *Laminaria digitata*, there may be met with, at low spring tides in the Firth of Forth, a *Coryne* which I am unable to refer to any described species. It grows in large entangled masses, attaining the height of 3 or 4 inches. It is much and very irregularly branched, but with the ultimate (polypiferous) ramuli mostly unilateral and springing nearly at right angles from the supporting branch. The larger branches are about 0·02″ in diameter, and the polypiferous ramuli about 0·01″. The branches are for the most part annulated at their origin; and the short polypiferous ramuli are similarly annulated throughout their entire length. The whole zoophyte is of a pale pink colour, becoming somewhat brighter in the polypes, and caused by the fine carmine-coloured granules of the cœnosarcal cavity and stomach, with their tint more or less modified by transmission through the surrounding structures.

The polypes have from 20 to 30 tentacula. In all the specimens I examined, four tentacles were situated in a regular verticil immediately behind the mouth; and the remaining tentacles were scattered over the body of the polype, with scarcely any tendency to a verticillate arrangement*.

From many of the polypes, gonophores were abundantly evolved. They budded forth from the upper side of the roots of the tentacles, each supported on the summit of a rather long peduncle, and including a single Medusa. Some polypes thus carried a gonophore at the base of almost every tentacle.

If this fine *Coryne* should really prove, as I believe, undescribed, I would propose for it the name of *C. eximia*, with the following diagnosis:—

Char.—Stem much and irregularly branched, forming dense entangled masses, with the ultimate ramuli mostly unilateral. Polypary corneous, with the ultimate ramuli annulated in their whole length, and the greater number of the other branches with annulations at their origin.

Polypes with from 20 to 30 tentacula, which are scattered over the surface of the body with scarcely any tendency to a verticillate arrangement, except the first four, which are disposed in a crucial verticil behind the mouth.

Gonophores simple, medusiferous, peduncled, springing from the bases of the tentacles over the greater part of the body.

The Medusæ, when liberated from the ectothecal investment

* A point of some interest in the structure of the polype may here be mentioned. The stomach is not a direct continuation of the canal of the cœnosarc, but the latter enters it upon the summit of a large papilliform lobe of the endoderm. This condition will, I believe, be also found in *Hydractinia*, and is probably not unfrequent among the Tubularidæ.

of the gonophore, are seen to be deeply bell-shaped. They are remarkable for their large size, measuring in their transverse diameter about 0·06″, and a little more in their vertical diameter. The manubrium extends to about the middle of the umbrella; and the mouth is destitute of tentacles or lobes. There are four radiating canals—each continuous, at the point where it intersects the circular canal, with a very extensile marginal tentacle. The tentacles are four in number, and originate in a large bulb containing carmine-coloured granules, while a dark-reddish-brown ocellus is superficially imbedded in a thickened portion of the ectoderm on the outer side of the bulb.

The bulbous base of the tentacle consists of a dilatation of the tubular system of the Medusa at the point where the radiating canals enter the circular, and having its endoderm greatly thickened and lobed, and secreting coloured granules. The ectoderm is here also much thickened on the inner side of the base of the tentacle, so as to constitute a cushion-like lobe containing imbedded thread-cells.

In its extended state the tentacle is seen to have its thread-cells grouped into very distinct knot-like clusters, which towards the end of the tentacle are spherical, and so situated as to appear to be strung upon the tentacle at intervals of about three times the diameter of a cluster, but are less regular in form, and more lateral and alternate in position near the base. The terminal group of thread-cells forms a spherical bulb on the tip of the tentacle, somewhat larger than any of the knot-like groups along its length.

There is no doubt of the complete continuity of the tube of the tentacle, and coloured granules may be traced from the bulb at the base to the very tip, though the peculiar arrangement of the cells of the endoderm near the base would easily give rise to the belief that the tube was interrupted by transverse septa.

There is a wide velum; and lithocysts are entirely wanting.

The peculiar motion of the corpuscles in the tubular system of Medusæ would naturally be referred to the action of vibratile cilia lining the walls of the canals, though I believe that these cilia have never yet become an object of direct observation. In the present little Medusa, however, I have distinctly seen them in the radiating canals near the spot where these vessels enter the circular canal, and again in the upper part of the canals near their origin in the stomach.

It will be at once apparent that the Medusa of *C. eximia* closely resembles that already described by Dujardin under the generic name of *Sthenyo*, as proceeding from a *Coryne* which he calls *Syncoryne decipiens**. Indeed, though the *Syncoryne*

* Ann. Sc. Nat. 1845.

decipiens of Dujardin is undoubtedly distinct from the species of the present note, it is difficult to find, in Dujardin's figure and description of *Sthenyo*, any character which can be justly considered as pointing to a specific distinction between the two Medusæ. It is probable that a more exact comparison with the living animal would result in the detection of differences not now apparent; but it is also by no means impossible that we should fail in the discovery of any such difference, and then we should have two Medusæ with characters specifically identical proceeding from two polypes with characters specifically distinct,—a fact, it will be at once seen, of great importance in its bearing on the general question of specific distinction.

At all events, it is quite certain that the value of the differences between the Medusæ of zoophytes is by no means necessarily parallel with that between the zoophytes themselves. An illustration of this remark is afforded by the Medusa of a *Coryne* which I described in the last Number of the 'Annals,' under the name of *C. Briareus*, and which is assuredly a true *Coryne*, though its Medusa is at least generically distinct from that just described as produced by *C. eximia**.

* Since the appearance, in last month's Number of the 'Annals,' of my note containing a description of *Coryne Briareus*, Dr. Strethill Wright has stated to me his belief that *C. Briareus* is the same zoophyte as one already provisionally described under the name of *Tubularia implexa* by Mr. Alder, who had not seen the polypes. To Mr. Alder's *Tubularia implexa* Dr. Wright had referred a *Coryne* which he describes in the July Number of the 'Edinburgh New Philosophical Journal' under the name of *C. implexa*. I am not, however, prepared to admit the identity of *Coryne Briareus* with either of these zoophytes, though Dr. Wright has allowed me an opportunity of inspecting specimens of his *Coryne* preserved in spirit.

It has so happened that Dr. Wright and I have been simultaneously engaged in the investigation of some portions of the invertebrate fauna of the Firth of Forth; and though our explorations have been conducted quite independently of one another, it is not to be wondered at, that, working as we have been over the same zoological ground, identical species should occasionally be discovered by both of us. This will explain how it has occurred that two other zoophytes which I have described as new in the paper just referred to, namely *Manicella fusca* and *Eudendrium baccatum*, have been simultaneously described by Dr. Wright in the same month's Number of the 'Edinburgh New Philosophical Journal,'—for I have no doubt of the identity with these species of Dr. Wright's *Bimeria vestita* and *Garveia nutans*. Dr. Wright's paper, however, purports to be a report of a communication made by him to the Royal Physical Society of Edinburgh in November 1858. Under these circumstances, I am quite willing to yield the priority of discovery and the right of naming to Dr. Wright, without, however, thereby admitting that claims of priority are necessarily valid when based only on communications to Societies which preserve upon their records no authenticated abstract of the facts communicated, and which defer publication until many months after the date claimed for the transaction. Such a practice, at the best, is sure to be

In this department of research, we are indeed placed in the anomalous position of being obliged to designate by distinct generic and specific names two organisms, as if they were totally independent, instead of being merely zooids of the same ovum —terms of one and the same unbroken life-series.

The necessity, however, which we are under of subjecting to distinct treatment, in descriptive zoology, the polypal and the medusal terms of this series, renders it impossible to abandon the practice, even though it be to a certain extent modified when continued observation shall enable us to refer every polype-sprung Medusa to its proper zoophyte.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

November 9, 1858.—Dr. Gray, F.R.S., V.P., in the Chair.

ON A LIVING OCTOPUS. BY J. P. G. SMITH, ESQ. IN A LETTER TO DR. GRAY, F.R.S.

"We found a Sea-spider at Goldthorpe Roads, in St. Bride's Bay, which I brought home, and have examined with much interest. Its habits and attitudes are very different from anything I ever saw figured. I enclose a sketch of its appearance when at rest. It seems very well, and shows great objection to be disturbed.

"I noticed that the habit of the Cuttle-fish, when in a large pool on the sands, was to get into a corner formed by a piece of rock, and to fix itself by the suckers of the arms, sac downwards—and that much more flattened and spread out than when lying on the bottom of the vase; the eyes made the apex of an irregular obtuse pyramid. It assumed at times a much darker and richer colour, almost chestnut, mottled with lighter shades; and its skin became more wrinkled; and instead of two inspirations and exhalations in succession, it only made *one* at about the same intervals, but with a much stronger jet of water through the siphon. Upon my return, I placed it in a pitcher of salt water inside the large foot-bath; and while I ran to the sea to fill a vessel with fresh salt water, it had leaped out upon the verandah, and then fallen into the road beneath, by which it was so much injured that it died in the night. After death it became pallid, with scarcely a trace of colour left, and the eyes wide open, round, and black. I felt quite sorry to lose the brute: there was something exceedingly interesting and grotesque about its habits.

attended with loss of time and labour to others who may be working on the same field, and would admit of great abuse in the hands of less scrupulous investigators than my friend Dr. Wright.

While in the pool, it walked about occasionally on its arms, with a spider-like movement.

"The colour was fawn on the upper side of the body and exterior of the arms, striated with darker hues, forming a sort of wrinkled network; beneath and inside the arms it is of an opalescent white: when disturbed or touched, the fawn or reddish-brown colour changes to a pallid-bluish hue. The eyes are very prominent and frog-like: by day they remain nearly closed, with the exception of a narrow slit; but towards night they open wide, and show deep-black orbs, with the inside of the eyelids tipped with gold: the lids and the skin for some little distance beyond are of an intense blood-colour. The animal has the power of extending the area so coloured, which is largest at night-time and when disturbed; while at rest it subsides considerably, and the colour does not extend beyond the lids. The arms are eight in number, united at their thicker ends by a web of skin; inside, and to their extremities, they are studded with numerous suckers. The belly or sac has a wide valve-like opening beneath each eye, through which the creature inhales water, and then, closing them, drives it out with great force through one or other of the two siphons, which are also situated below the eyes, and close to the valves of the stomach.

"While at rest, it coils the arms together beneath the sac-like body, and remains, attached strongly by the suckers in the thick parts of its arms, at the bottom of the vase, the eyes uppermost; and the back, gently expanding and contracting, is bent forward over the arms; at long intervals it draws two deep inspirations, driving out the water through the siphons with great force. It uses only one siphon at a time; and the two inspirations follow in quick succession.

Fig. 1.

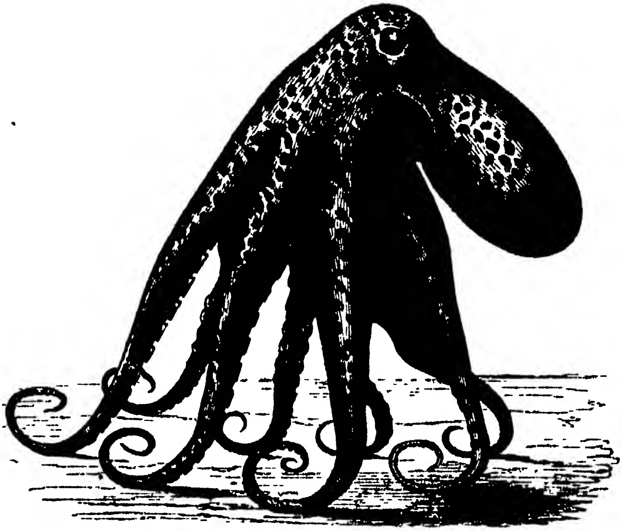
"I noticed the intervals of these deep inspirations as follows. R. means that the right siphon, and L. the left, was used.

	h.	m.	s.
R.	10	3	15
R.	10	7	25
R.	10	10	40
R.	10	15	0
R.	10	20	0
L.	10	25	20
R.	10	30	15

"The appearance of the animal when in this position is wonderfully like a frog with a very large mouth, the marked division between the fawn and the whitish colour of the upper and under surface suggesting the idea of the line of the aperture of the mouth (see fig. 1).

"It seems to use the right-or left-hand siphon indifferently. The siphons are about $\frac{1}{3}$rd of an inch in diameter. It has the power of walking or moving about upon its arms. It swims rapidly in a

Fig. 2.



horizontal attitude, elongating the body, and propelling itself with a frog-like motion, by opening and contracting its arms.

"When I poured off the water, it discharged, at two or three jets through the siphons, a small quantity of black fluid, which remained undissolved for some time, in small cobweb-like clouds, floating about on the water. It has the power of contracting the skin above the eyes, so as to make a small horn-like projection; but this only rarely appears. The belly gives you more the idea of a *snout* than of anything else; it is about the size of a full-sized Turkey's egg. It walked high, on the tips of its arms (see fig. 2)."

November 23, 1858.—Dr. Gray, V.P., F.R.S., in the Chair.

Notice of five Species of Bats in the Collection of L. L. Dillwyn, Esq., M.P.; collected in Labuan by Mr. James Motley. By Robert F. Tomes.

1. Pteropus hypomelanus, Temm. Esquiss. Zool. i. p. 61, 1853.

Although the specimen of *Pteropus* included in the collection forwarded to me for examination differs very materially in colour from

the ordinary examples of the above species, the distribution of the colours themselves, and the quality and quantity of the fur, together with an absolute similarity in all other respects, including that of size, leave no doubt as to its identity with that species. In colour it more nearly resembles some of the examples of *P. funereus*, a species to which it cannot be referred, as it differs greatly, among other respects, in the form and size of its ears*.

Instead of the usual light rufous on the nape and shoulders observable in the ordinary examples of *P. hypomelanus*, the specimen from Labuan has these parts of a purplish-brown, strongly tinged with claret-colour; the fur of the back is also darker; and the under parts, instead of being light reddish-brown, have the same dark-purplish colour as the back of the neck, but less bright.

I have compared the specimen with others from Ternate and from Macassar, the latter having been collected by Mr. Wallace. The comparatively short and rounded ears will at once distinguish the dark variety of this species from *P. funereus*, in which they are longer and more pointed.

2. Pachysoma brevicaudatum, Is. Geoff.—*Vesp. marginatus*, Hamilton?—*Pteropus marginatus*, Horsf.—*Pt. marginatus*, *Pachysoma marginatum*, and *Pachysoma brevicaudatum*, Temm.—*Cynopteris marginatus* and *C. Horsfieldii*, Gray.

Of this species there are two specimens in the collection, both having the bright-rufous hair on the sides of the neck which characterizes the variety which has been called by Dr. Gray *Cynopteris Horsfieldii*. This vivid colouring occurs most frequently in the Ceylon specimens. After comparing a considerable number from various localities with the type specimens of *P. brevicaudatum* in the Paris Museum, I have arrived at the conclusion that all the above species, given as synonyms, are referable to it.

3. Phyllorrhina labuanensis, n. s.

I have hitherto seen but one specimen of Horse-shoe Bat resembling the one from Labuan, and that was obtained at Sarawak by Mr. Wallace. Amongst all the descriptions of Asiatic *Rhinolophidæ* which I have been able to examine, I have not hitherto met with one which applies to this species; and I therefore regard it as new, and describe it as follows:—

Facial crests, so far as can be ascertained from the inspection of dried specimens, very much like those of *Phyllorrhina speoris*. Upper incisors rather broad and almost contiguous; in *P. speoris* they are narrow, and have a considerable central opening. Lower incisors small, very regular, and trilobed; canines, above and below, rather long and slender. Ears of medium size, as broad as high,

* All the examples of *P. funereus* which I have examined have had the unworn teeth of young individuals, and moreover exhibited further indications of immaturity in the broad and flattened longitudinal crest of the cranium: in older examples this becomes prominent and acute. I regard the *P. funereus* as the young of *P. edulis*.

pointed, and the outer margin very faintly hollowed out towards the tip.

The wings are rather long and narrow, the fourth finger not exceeding in length the two basal phalanges of the longest finger. Thumb short, more than half enveloped in membrane.

Fur of the upper parts tricoloured, dusky-grey at the base, succeeded by yellowish-brown, and this again by darkish umber-brown, with the extreme tips a little paler. Beneath, the fur is faintly bicoloured, lightish brown at the base, with the tips of the hairs rather paler.

The specimen in my own collection, from Sarawak, differs in having the colours much more vivid. Fur of the upper parts bright cinnamon-brown for two-thirds of its length, succeeded by bright rufous of a somewhat darker hue, with the extreme tips of the hairs a little paler, giving, when viewed in some lights, a slightly hoary appearance. Beneath, the fur is lightish rufous, a little darker at the root than at the tip. Membranes rather dark and shining.

The following are the dimensions of these specimens :—

	Labuan.		Sarawak.	
	"	'''	"	'''
Length of the head and body, about ..	2	3	2	2
——— of the tail	0	10½		
——— of the head	0	9½	0	9
——— of the ears	0	5	0	5
Breadth of the ears	0	5½	0	6
Length of the fore-arm	1	10	1	9½
——— of the longest finger	2	10	2	7
——— of the fourth finger	2	1	1	11
——— of the thumb and claw	0	3	0	3
——— of the tibia	0	8½	0	8
——— of the foot and claws	0	4	0	4
Expanse of wings	12	0	11	8

Obs.—The species to which this is most nearly affined is the *Phyllorrhina speoris*; but it may be readily distinguished by the following points of difference:—*P. speoris* is constantly somewhat larger than the present species, and has the head, but more especially the canine teeth, considerably larger. The tibiæ, too, are not only longer in actual measure, but also longer in relation to the size of the animal, in *P. speoris*, than in the present species. Again, in *P. speoris* the free portion of the thumb is longer than the enclosed part, whilst in the present species the enclosed portion is the longer. To these differences may be added, that the membranes are much less translucent, but more shining, in the Labuan species than in *P. speoris*.

4. Scotophilus nitidus, n. s.

In M. Temminck's monograph of the genus *Vespertilio*, several small Asiatic species are described which are affined to the common Pipistrelle Bat of Europe, and appertain to the genus *Scotophilus*.

They are mostly smaller than that species, but are characterized by the same subgeneric forms. The following are the species alluded to:—*Vesp. brachypterus*, *V. pachypus*, *V. abramus*, and *V. Akokomuli**.

To these may be added the *V. coromandelicus*, F. Cuv., one of the smallest Bats known; and the species I am about to describe must be placed in the same list.

In size it is one of the smallest, appearing but little larger than the *V. coromandelicus*; but on closer examination it is found to be considerably the larger of the two, the slenderness of the bones of the limbs tending to give it an unsubstantial and small appearance.

The head is somewhat more elevated, and the muzzle rather less obtuse than in *S. lobatus* or *S. coromandelicus*; but the ears and tragi are shaped precisely as in those species: viz. the ears are small and ovoid, with the ends rounded, and with scarcely a perceptible emargination at their outer margin; and the tragus is short, of nearly uniform breadth, curved inwards, and round at the end. As in the other species of this group, the wing-membranes spring from the base of the toes; and these latter constitute one-half the entire length of the foot. The free portion of the thumb is somewhat longer than that which is enclosed in the membrane. The tip of the tail is free. The bones of the wings and legs are more slender in relation to their length than those of its congeners; and the tibiæ are rather longer relatively.

The fur does not anywhere encroach on the membranes, either above or beneath, but is strictly confined to the body; it is of medium length, and thick and silky. That of the upper parts is unicoloured, dark chestnut-brown, without variation of tint on the different parts of the body; beneath bicoloured, dark brown at the base, tipped for a third of its length with reddish-brown, a little paler on the pubes.

Such is the colour of the specimens from Labuan; but two others in my own collection, obtained by Mr. Wallace at Sarawak, have all the upper parts of a dark shining brown, with scarcely a tinge of chestnut; and the under parts have the fur tipped with greyish-brown instead of rufous.

The cranium, in its general conformation, closely resembles that

* I do not include the *V. tralatitius* of the same author, because it has been shown by Dr. Gray to be quite a distinct species from the original *V. tralatitius* of Dr. Horsfield. It is in fact a true *Vespertilio*, bearing a great resemblance to the *V. mystacinus* of Europe. *V. tenuis*, according to M. Temminck, is so closely affined to it, as to be with difficulty distinguished from it; and we are therefore led to believe that this is a true *Vespertilio* also. The so-called *V. imbricatus* of Temminck answers well to the true *V. tralatitius*, and is, I have no doubt, referable to that species. Of the *V. imbricatus* of Dr. Horsfield I have as yet seen but one example, the type specimen, in the Museum at the India House. *V. brachypterus* is most likely the young of *V. tralatitius* of Horsfield. *V. pachypus* is probably a good species; and the same may be said of *V. Akokomuli*; but M. Temminck's description and figures of *V. abramus* apply so exactly to the *Scotophilus lobatus* of Gray, that it will probably have to be quoted as a synonym of the latter species.

of the ***Pipistrelle***, but has the facial portion a little broader. As in that species, there is a rudimentary premolar, immediately behind the upper canine, and placed in a line with the other teeth, so as to be visible from the outside. In *S. tralatitius* the second premolar is contiguous to the canine, and the first or rudimentary one is placed in the angle formed by the two, and is only seen from the inside. But the greatest peculiarity exists in the form and arrangement of the upper incisors. In the generality of species appertaining to this group, they are arranged in pairs, with a considerable central opening, and the two inner ones somewhat longer than the outer, and more or less in advance of them; but in the present species, the outer ones, adjoining the canines, are more in advance than the inner ones, and are merely rudimentary. The curve which is made by the row of upper incisors has, by this arrangement, its concave surface directed forwards instead of backwards, as in other species.

The number of the teeth may be thus given:—

Inc. $\frac{2-2}{6}$; Can. $\frac{1-1}{1-1}$; Prem. $\frac{2-2}{2-2}$; Mol. $\frac{3-3}{3-3}=\frac{16}{18}$.

	Labuan.		Sarawak.	
	"	'''	"	'''
Length of the head and body . .	1	6	1	6
——— of the tail	1	3	1	3
——— of the head	0	6	0	6½
——— of the ears.	0	2½	0	3
——— of the tragus.	0	1½	0	2
——— of the fore-arm	1	2	1	1½
——— of the longest finger	2	2	2	3
——— of the fourth do.	1	6	1	7
——— of the thumb.	0	3	0	2½
——— of the tibia	0	5¾	0	6
——— of the foot and claws	0	3½	0	3
Expanse of wings	9	0	8	9

The above are the dimensions of two *adult* individuals from the localities mentioned; younger ones differ in having the *fingers* considerably shorter, and the *fore-arm* a little shorter.

5. Scotophilus circumdatus? *Vespertilio circumdatus*, Temm.

I refer this species, with some doubt, to the *V. circumdatus* of M. Temminck. It agrees with it in most particulars, such as the form of the head and ears, and in having the wing-membranes extending only to the extremity of the tibiæ; but it differs in being somewhat smaller, in having the fur shortish and unicoloured, whereas that of *circumdatus* is, according to M. Temminck, long, and of two colours.

For the present, I prefer leaving it under the name above given, until a greater number of specimens can be examined.

I have to thank Mr. Dillwyn for the opportunity of describing the species mentioned in this paper, and for the great liberality with which he has allowed me to make any use of his specimens which might be desirable for the purpose of description.

On Two Species of Ant-birds in the Collection of the Derby Museum, at Liverpool. By Philip Lutley Sclater.

1. Myrmeciza exsul, sp. nov.

Obscure brunnescenti-castanea, cauda concolore; capite toto undique et corpore infra ad medium ventrem nigris: ventre imo crisso et hypochondriis dorso concoloribus: alarum tectricibus minoribus nigricantibus ad apicem albo punctatis: campterio albo: rostro nigro, pedibus obscure brunneis: periophthalmio denudato.

Long. tota 5·0, alæ 2·5, caudæ 1·7, rostri a rictu 0·85, tarsi 1·2.

Hab. In isthmo Panama (*Delattre*) et in rep. Nicaragua.

Mus. Derbiano, sp. 4939, et Acad. Philadelph.

This species may be placed between *M. hemimelæna* and *M. cinnamomea* in my arrangement. In colouring it somewhat resembles the former, but it is of a much stronger build, and has no white markings on the interscapularies. The bill is shorter than in *M. cinnamomea*, but the form otherwise nearly similar. The single specimen in the Derby Museum is marked with one of Delattre's tickets, "Mâle, Panama," and was acquired by the late Lord Derby in 1846. Another example of this same bird, of which I have a note, is in the splendid collection belonging to the Academy of Natural Sciences of Philadelphia; it is labelled '*Nicaragua.*' I took a description of it in the autumn of 1856, but was loath to publish it without seeing a second specimen.

2. Dysithamnus olivaceus.

Thamnophilus olivaceus, Tsch. Consp. Av. p. 278, et Faun. Per. p. 174.

Dysithamnus olivaceus, Cab. Orn. Not. i. 223; Bp. Consp. p. 199.

♂. *Olivaceus: pileo cinerascente, capitis lateribus concoloribus: subtus pallide cinereus; gutture ventre medio et crisso albicantibus: campterio albo: alarum tectricibus albo anguste marginatis.*

Long. tota 5·0, alæ 2·5, caudæ 1·7.

Hab. In Bolivia (*Bridges*).

Mus. Derbiano.

A distinct species of *Dysithamnus* nearly allied to *D. mentalis*, but recognizable by the absence of the black ear-mark, and darker colour of the sides below. The example in the Derby Museum from which I take my characters, was obtained through Mr. Cuming in 1846, and was doubtless among the Bolivian birds collected by Mr. Bridges.

I have to express my acknowledgments of the liberality of the Trustees of the Derby Museum, in allowing me the use of these and several other birds for examination. Without actual comparison of specimens it is nearly hopeless to attempt to determine species of this and other similarly-complicated groups.

December 14, 1858.—Dr. Gray, F.R.S., V.P., in the Chair.

On Zoanthus Couchii, Johnston.

By E. W. H. Holdsworth, F.L.S., F.Z.S., etc.

The existence in our seas of a compound Zoophyte belonging to a group so essentially tropical as the *Zoanthidæ*, was first made known by Mr. R. Q. Couch, who obtained a small species from deep water near the Cornish coast. It was subsequently described and figured in Dr. Johnston's 'British Zoophytes,' and has been since eagerly sought for, but apparently without success; or if captured, its characters have not been positively recognized. There is reason, however, to believe that the original description was imperfect; and it is probable that specimens of a compound Polype, found by Mr. Barlee and others along our northern coasts, and some lately obtained by myself in Torbay, may all be referred to *Zoanthus Couchii*. They are certainly identical with the animal which Dr. Johnston placed with some hesitation among the Sponges, and described under the name of *Dysidea papillosa*; and this was believed by Prof. Edward Forbes to be the same as the Cornish *Zoanthus*. As the specimens recently found differ in some important particulars from those described by Mr. Couch, I have thought it desirable to point out their characters, and to give some details of certain parts of their structure which are peculiar to the family *Zoanthidæ*, leaving their specific distinctness an open question, until we know more of the original *Zoanthus Couchii*.

The living polypes exhibited were dredged on the 12th of October last, in 10 or 12 fathoms water, at about a mile from the eastern headland of Torbay, and, although small, agree in other respects with the probably maturer examples from other parts of the coast. The special characters of the *Zoanthidæ*, which consist in their increase by budding, and their mode of distribution over the surfaces to which they are attached, are subject in this species to considerable variation. One group of six polypes, on the inside of a valve of *Cardium rusticum*, is arranged in a linear series, as in the typical forms of the restricted genus *Zoanthus*, and is the result of budding in one direction only; others are scattered over the surface of a flat stone, and have no perceptible connexion with one another, except in a few instances where two or three of them are united; the isolated polypes are perhaps the produce of separate ova, and in time may develope their compound character by the usual process of gemmation. Another form of growth is the one under which this zoophyte has been most commonly known as *Dysidea papillosa*, and may be well seen in a remarkably fine specimen from Shetland, and now in the collection at the British Museum. In this example the polypes form a compact group, connected in every direction by a general expansion of the basal membrane, which is extended over the whole outer surface of a small univalve shell, and also lines the interior for a considerable distance. Mr. Alder has observed that a *Natica* is the usual support for this form of development; but in this instance the shape of the incrusting mass is more like that of a small

Buccinum, or a *Purpura*. In these varying modes of growth, we find a gradual transition from the linear budding of *Zoanthus* proper to the aggregation of the polypes in some species of *Polythoa*; but in the typical members of the latter genus, the polypes are not only connected at the base, but have their bodies also severally united, so as to form a solid mass; and a more decidedly compound nature exists in them than we find in any of the varieties of the present species; so that, although partaking of the characters of both genera, *Zoanthus* appears to be the one to which this is most nearly allied. An evident approach to the same intermediate form may be observed in the reticulate arrangement of the connecting bands of *Z. Bertholetii* from the Red Sea.

In our British species, the body forms a cylinder from 2 to 4 lines high, by about half that in breadth, and is clothed with a dense coating of fine sand, which at the upper extremity is divided into 14 deeply-cut marginal teeth; these cover the top of the column when the animal is closed, but are turned a little outwards during expansion. The tentacula are moderate in length, slightly tapering, smooth, and not capitate; they are arranged in two rows containing 14 each, of which the inner series are rather the longer, and are placed opposite the angular prolongations of the column, those of the outer row alternating with them. Fourteen tentacles in each row appear to be a character of specific value, as I find that number constant in specimens of various sizes, and they correspond with the marginal divisions. The disk, which is generally concave, somewhat exceeds the diameter of the body; and the prominent mouth opens with a simple linear orifice. The general colour of the disk and tentacula is a pale transparent brown, becoming opake white around the mouth and at the tips of the arms; and all the intermediate parts are finely speckled with the same tint. At first sight the tentacles appear to be knobbed, as in *Corynactis* and some of the Coralligenous Polypes; but their form is really quite simple, and the capitate appearance of these organs is due solely to the conspicuous colour of their extremities.

Among the external characters of this family, the serrated margin of the column is remarkable; but an examination of the animal shows that this structure is a simple provision for enabling a polype so peculiarly coated to close its disk perfectly, and in the contracted state to be completely protected by its sandy covering. Closure of the disk in the soft-bodied *Actiniæ* is effected by the action of the muscles surrounding the upper extremity of the body; and as the skin is soft and yielding, contraction takes place equally on every side, and is continued until the edges of the column meet in the centre. In *Zoanthus*, the case is different; fine sand being densely impacted into the epidermis, little or no contraction can take place, and the polype would be unable to close in the usual manner if this hard covering were uniformly extended to the margin of the disk. Under the microscope, the wall of the column is seen to terminate in a number of triangular processes or teeth, united at the base, and covered externally with sand like the rest of the body; these prolongations are connected throughout their length by a thin membrane,

which is crossed by the ordinary transverse muscles, whose contraction brings the edges of the teeth in contact, at the same time necessarily inclining them towards the centre, and thus effectually closes the disk; the animal being then entirely covered and protected by the investing sandy coat. It will be observed that the apparently marginal teeth are in reality only parts of the wall of the column, and that intervening triangular pieces are as it were excavated from the integuments, leaving only the internal membrane and muscular bands. The nature of this adventitious covering also deserves attention, being the only character in which this polype at all resembles *Dysidea fragilis*, the sponge with which it was formerly associated. It is almost entirely composed of fine angular particles of siliceous sand, brought in contact with the body and connecting membrane of the polype by the action of the sea, and retained by, and incorporated in the cuticle; its extraneous character is evident from the occasional presence of other matters mixed with the sand, but the latter substance is in most cases the only material employed. Similar grains of sand abound in the sponge; they are not confined, however, to the exterior, but are scattered throughout the mass, and cover the interlacing fibres in every direction.

Independently of its different composition, this sandy coating in *Zoanthus* cannot be regarded as at all analogous to the true corallum of the Madrepores. Here it is the actual polype which is enclosed in the hard covering, and this, when tested with nitric acid, shows no trace of calcareous matter; in the Madrepores, on the contrary, the polype is as delicate and soft-bodied as any of the *Actiniæ*, and when expanded, rises above and clothes the upper portion of the corallum, which is entirely secreted by the internal tissues of the animal, and is composed essentially of carbonate of lime extracted from the seawater; in fact, the hard parts constitute an external covering in the one animal, and an internal skeleton in the other.

In its explanate growth, or increase by budding from the base only, *Zoanthus* strongly resembles the *Caryophyllacea*, and by some naturalists is associated with that tribe of Coralligenous Polypes; but many of its characters point to a nearer relationship to the *Actinidæ*, in which we sometimes find a similar deposition of extraneous matter on the cuticle, although in a slighter degree and less persistent: the smooth simple tentacula are also very unlike those of the Coral Polypes, in which their surface is generally studded with little wart-like prominences enclosing the thread-cells. With our present scanty knowledge of the *Actinidæ* found in different parts of the world, and the insufficient descriptions that we possess of most of the coral animals, it is difficult, if not impossible, to determine the true position of the *Zoanthidæ* among the Helianthoid Polypes. An examination of the tropical seas, in which they abound, and where they attain a size considerably exceeding that of our British species, may lead to the discovery of intermediate forms showing the true affinities of this now isolated group; but at present I am inclined to regard them as representing the budding form of growth in the Non-coralligenous Zoophytes, as the fissiparous mode of increase is exemplified in many of the true *Actiniæ*.

On the 9th of November last, Dr. Gray brought before this Society a notice of a curious form of *Zoanthus* sent to him by Mr. George Barlee from the Shetland seas, and for the reception of which he proposed the new genus *Sidisia*. He has kindly allowed me to describe this polype; and it is therefore with some regret that, after a careful examination of it, I must question its generic or even specific distinction from *Zoanthus Couchii*, the subject of the previous part of this paper. The great peculiarity of these polypes consists in their being entirely free, no parts of the specimens at the British Museum showing any superficial trace of attachment. Another remarkable character is their irregular mode of budding, and may be briefly described as one polype growing out from another without the intervention of the usual connecting bands; this budding takes place from the base of the parent polype in an opposite direction, or at various angles with the original line of growth, the branches again sometimes throwing out buds from near their own bases. Mr. Barlee states that some of the specimens were attached, but most of them came up in the dredge free, and that they abounded on muddy ground. This situation is I think very significant, and sufficient to explain the peculiarities of the animal. As I have before mentioned, it is the habit of *Zoanthus* to be attached to some stone or shell, and the first sign of its increase is in the expansion of the basal membrane either on one or all sides of the polype; from this expansion the young bud forth at various distances from the parent, and they in time develope similar offshoots. Such is the case when the ova fall on places suited to their natural growth; but if by chance they are deposited on a muddy bottom, or where the stones are only large enough to afford attachment to a single polype, I think an irregular mode of growth may be reasonably anticipated, and a variation expected in the character which, above all others, is likely to be affected by the change of circumstances. By the motion of the sea, the position of these free polypes must be continually shifting, consequently no part of their surface can be permanently uppermost; and under these circumstances, with a natural tendency to grow upwards, regularity of budding would seem to be impossible. As might be expected, scarcely two of the specimens I have seen are precisely alike, which adds to the probability of the suggested explanation of their irregular growth. The fact of the characters of the disk, and the number of the tentacula and marginal divisions being identical with those of the animals first described, is a strong argument also in favour of their all being only different forms of the same species.

Additional Observations, communicated March 8, 1859.

Some fine groups of *Zoanthus Couchii* from Torbay having lately come under my notice, I have been enabled to obtain a better knowledge of the species than I possessed when I recently laid before the Society a description of its characters. I therefore venture to add a few remarks on certain points, which before were considered as relating to particular specimens, rather than to the species generally.

First, as to size. The dimensions given in my previous communication were those of the largest polypes that I had seen alive, which were described as being from 2 to 3½ lines in height by about 1½ in breadth; such also is the size of many that I have seen since; but among them have been several examples in which these measurements have been nearly doubled, and with the increase of size a power of varying the shape of the body has been exhibited, almost equalling that of *Corynactis*, so well known for the remarkable changes of form that it undergoes. This mutability of shape is dependent in a great measure on the degree of density of the external coating of sand, which does not increase in proportion to the growth of the animal; so that while the half-grown polype is closely imprisoned in its hard covering, older and larger individuals are less thickly clothed; and when in a state of expansion, the grains of sand are sufficiently separated to allow the integument to be seen between them, and thus to permit that mobility of body which is so characteristic of the *Zoanthidæ*. The rigid form in the first specimens that I examined, was one of the difficulties that I met with in identifying them with Mr. Couch's description of the species.

There are some other points of disagreement which I have little hesitation in saying are due to a misconception on the part of Mr. Couch when preparing the original description. I refer especially to the statement that "the surface of the body is minutely glandular," and that "radiating from the mouth are numerous rows of whitish glandular-looking bodies, which are the tentacula in a contracted state;" in both these cases it is evident that the character of the sandy covering has been misunderstood. Secondly, as to the growth of the basal membrane. I have previously referred to it under the linear and expanded forms, which I then ventured to think were only modifications in the development of one species: the recently captured specimens throw some further light on the subject. Among various groups on one large shell, I have found lines of polypes sometimes sending out lateral shoots from the basal membrane, and these again dividing; others expanding, so as to include two or three polypes in parallel series, and in one instance a single specimen was observed with the basal expansion extending equally on every side: again, the membrane leading from a group spreads at times over the surface of the shell in an irregular manner for a considerable distance, without any bud arising from it; so that no special form of growth can be considered as characteristic of the connecting membrane in this species. The rate of development in the members of a group is also of the same uncertain character—a large polype being occasionally followed by a very small one, and that succeeded by two or three of intermediate but varying size; in fact, except in certain characters, the development of this *Zoanthus* is subject to great irregularity; and the cases above mentioned appear to me to confirm the opinion that I have before expressed of the specific identity of the linear form of growth with that which has been found in the Northern seas, overspreading the entire surface of small univalves.

MISCELLANEOUS.

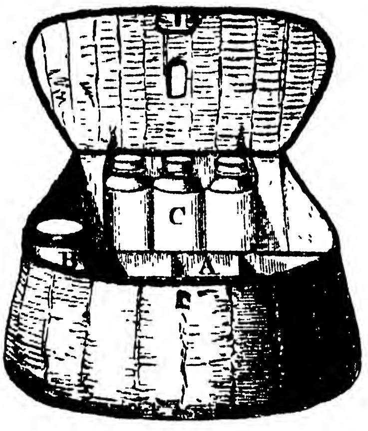
Collecting-Basket for the Sea-side.

To the Editors of the Annals of Natural History.

Claremont Lodge, Park Street, Camberwell,
July 18, 1859.

Gentlemen,—I beg to communicate the description of a basket, the contrivance of a friend, which I have found very convenient for shore-collecting (especially when an assistant to carry tools, &c., cannot be easily obtained), and which I believe will be acceptable to those of your readers who contemplate a visit to the sea-side at this season.

The foundation of the basket consists of the creel used by anglers, in the lower part of which is placed a lining of sheet gutta-percha divided into three compartments by partitions of the same material made water-tight and fitting into the right-hand side of the basket (represented *in situ*, fig. 1 A), and leaving space in the left-hand side



for packing a pickle-bottle, B. A bag of canvas, stitched into three divisions, is sewn to the back of the basket at C, for the purpose of receiving three wide-mouthed bottles: two or three chisels, &c., can be laid across the gutta-percha partitions; and the hammer, if not carried in a belt, can rest on the centre division, with the handle through the hole in the lid. The whole contrivance can readily be fitted by any person able to join the pieces of gutta-percha: it is carried by a strap slung over the shoulders, after the manner of the botanist's *vasculum*.

I used the basket last autumn at Torquay, and found it very convenient, as it left the hands free and unencumbered—a very desirable matter in climbing among the rocks.

I am, Gentlemen,
Yours truly,
W. T. Suffolk.

On the Heating of the Soil of high Mountains, and its Influence upon the Limit of eternal Snow and Alpine Vegetation. By CH. MARTIUS.

Theory indicates, and experience proves, that the atmosphere absorbs a notable proportion of the heat transmitted by the sun to the earth. M. Pouillet estimates this quantity at ·4 of the total heat transmitted by the sun to the earth at any given moment. As the calorific ray which falls upon an elevated summit traverses a less considerable thickness of the atmosphere than that which arrives at the level of the sea, it ought to heat the summit of the mountain more than that which penetrates as far as the plain; but the rarefied air surrounding the summit does not become so much heated as that of the plain: hence it should follow that the soil at the surface and for about a foot deep, upon a high mountain, should become more heated than the air, while the contrary would take place in plains little elevated above the sea. Now this is fully confirmed by experience, as I show in this notice, through observations made in August 1842 on the Faulhorn by MM. Bravais and Peltier, and in Sept. 1844 by M. Bravais and myself, compared with corresponding ones made at Brussels by M. Quetelet, and with those made in Spitzbergen in 1839 by the Meteorological commission attached to the expedition of 'La Recherche.'

This relatively considerable heating of the surface of the soil exerts a powerful influence upon the physical geography of the high Alps: it is this which moves upward the line of eternal snow, the melting of which is principally due to the heat of the subjacent ground. All travellers who have ascended these elevated regions know that in the Alps the snows melt underneath in consequence of the heat of the soil. Often, when the foot is placed on the edge of a snow-field, the weight of the body breaks a superficial crust which does not rest on the soil. Sometimes we perceive with astonishment underneath these icy vaults Soldanellas in flower (*Soldanella alpina*, L., and *S. Cludii*, Thom.), with tufts of the leaves of the Dandelion. It is likewise the melting of the snow in contact with the soil which causes the sliding of the snow-fields which form the spring avalanches of turfy declivities. Finally, it is this heating which explains the variety of species of plants, and the number of individuals which cover the soil at the very limit of the eternal snows: thus, upon the terminal cone of the Faulhorn, the height of which is about 250 feet, the superficies about 11 acres, and the altitude nearly 9000 feet, I have gathered 131 species of Flowering plants. On the Grands-Mulets (needles of laminated protogene rising in the midst of the glaciers of Mont Blanc, at 10,000 feet above the sea), I have noted nineteen Phanerogamia,—viz. *Draba vladinensis*, Wulff., *Cardamine bellidifolia*, L., *Silene acaulis*, L., *Potentilla frigida*, Vill., *Phyteuma hemisphæricum*, L., *Erigeron uniflorum*, L., *Pyrethrum alpinum*, Willd., *Saxifraga bryoides*, L., *S. grœnlandica*, Lap., *S. muscoides*, Auct., *Androsace helvetica*, Gaud., *Avena pubescens*, DC., *Gentiana verna*, L., *Luzula spicata*, DC., *Festuca Halleri*, Vill., *Poa laxa*,

Haencke, *P. cæsia*, Sm., *Agrostis rupestris*, All., *Carex nigra*, All.; but then, on the 28th of July, 1846 (the temperature of the air in the shade being 48°·9 Fahr., in the sun 52°·5 Fahr.), the schistose gravel of the rock in which these plants vegetated indicated a temperature of 84°·2. As a contrast, I will again cite Spitzbergen. This archipelago, whose shores may equally be regarded as touching the limits of eternal snows, occupies no less than 4½° of latitude by 12° of longitude, and yet contains no more than 82 Phanerogamia.

In the Alps, the plants are heated by the soil which bears them more than by the air which surrounds them; a vivid light favours their respiratory functions; and even when the temperature descends to the freezing-point during the day, a layer of recent snow preserves them even in summer from the accidental chills which always accompany bad weather on high mountains. Equally sensitive to cold and heat, they can only bear temperatures between about 32° and 59°; constantly moistened by clouds or irrigated by the water flowing from the melting snow, they require the utmost care to make them prosper in the plains; for the gardener must defend them against the cold of winter and the heats of summer, yet without keeping them from the influence of light. At Spitzbergen, on the contrary, in spite of the perpetual day of summer, the vegetation is poor and scattered, because the rays of the sun, being for the most part absorbed by the great thickness of the atmosphere and the continual fogs, can neither heat nor illuminate this frozen country.—*Comptes Rendus*, May 16, 1859.

Note on the Artificial Propagation of Salmon. By A. D. Bartlett.

The Committee of the Australian Association have been trying a series of experiments with a view of ascertaining the possibility of conveying Salmon to Australia, for the purpose of introducing this noble fish into the rivers of that country. The difficulty is to convey them across the tropics; and the object of these experiments, which have been carried on in the Crystal Palace under my supervision, has been—

1. To filter a sufficient quantity of water to supply a running stream for the spawn or young fish.

2. To ascertain the highest amount of temperature in which they would live.

3. To discover the best and most economical means of lowering the temperature, that they may be kept alive while passing the tropics.

In order to accomplish the first object, arrangements were made with the Charcoal Filter Company to fix filters to supply a running stream through long boxes, which were partly filled with gravel and small stones, upon which the Salmon ova were to be placed.

Mr. Ramsbottom being engaged to obtain the ova, to ensure their being perfectly impregnated, and to deposit them in the breed-

ing place in the Crystal Palace, proceeded to Wales, and on the 5th of February obtained from two female fish at least 20,000 ova, which, by the usual process adopted in the artificial propagation of fish, he rendered fertile, and then starting immediately for the Crystal Palace, arrived there February 7th, and deposited the ova in the breeding-boxes, which had been duly prepared. Unfortunately, at this time the filters had ceased to act, and the water supplied by the Lambeth Water Company was obliged to be laid on in its usual state. In a few days the ova and the bottom of the breeding-boxes became covered with a dark deposit, from the impure condition of the water, and large numbers of the ova died daily in consequence. Another batch of filters was then fixed, and a fresh supply of filtered water obtained; and no more sediment was deposited upon the ova. Notwithstanding this, they continued to die for some days; but about the 20th, the whole of the deposit, which had settled upon the bottom of the boxes and upon the ova, began to rise towards the surface in the form of Confervæ; the bottom of the boxes and the remaining ova appeared quite fresh and clean; the surviving ova rapidly assumed the perfect state of the young fish; and on March 7th the young fry began to move about (the outer covering being thrown off), endeavouring to hide themselves between the stones and gravel. The temperature of the water during this experiment was 57°. In order to ascertain if any advantage could be gained by placing some of these in filtered water at a lower temperature, a number of them were carefully removed to a glass tank, supplied with a fountain at the temperature of 54°. In this they appeared to be doing well, were evidently larger and more active, and exhibited great promise. Unfortunately, on the morning of the 13th, the workmen having been ordered to make some alteration in the water pipes in the building, turned off the water, leaving the young salmon, together with the ova which had not yet been hatched, five or six hours without fresh water, in the tropical end of the building: in consequence of this, they were all destroyed, and this interesting experiment delayed for a whole year, as it is impossible to obtain the ova until the next breeding-season.

There are, however, some important facts learned from this experiment, one of which is the early period of hatching. Previous experiments have shown that 60 days usually expire before the young come to life; sometimes 140 days have passed. This experiment has proved that the young fish can be hatched in 30 days: it yet remains to be tested whether this is an advantage. It is certain that in the case of more highly organized and warm-blooded animals, their production at an earlier period than the ordinary one is attended, if not with death, at least with great debility; while, on the other hand, it is not possible to retard the operations of nature beyond the ordinary period without destroying the mother or the offspring. There are many circumstances that induce the belief that the young fish would be stronger by the early development; but no positive conclusion can be arrived at without further experiments.—*Proc. Zool. Soc.* Mar. 8, 1859.

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[THIRD SERIES.]

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XVI.—*Description of a new Genus of West African Snakes, and Revision of the South American* Elaps. By Dr. Albert Günther.

[With a Plate.]

The publication of the description of the following interesting Snake has been delayed in consequence of the author having some knowledge of another *West African Snake*, besides *Atractaspis irregularis, with entire subcaudal plates and without loreal shield*, described in a MS. said to be ready for publication. This snake, however, has proved to belong to the venomous tribe*, and to be widely different from that in the Collection of the British Museum. The latter is to be referred to the family Calamaridæ, along with *Aspidura* and *Haplocercus*.

Elapops, n. g.

Body and tail moderately elongate, the latter tapering; two pairs of frontals, two nasals, nostril between; *loreal none*, united with the posterior nasal; one anterior and one posterior ocular. Scales smooth, in fifteen rows; anal and *subcaudals entire. Teeth equal, smooth.*

Elapops modestus, n. sp. (Pl. IV. fig. C.)

Seven upper labial shields. Uniform greyish olive; beneath yellowish olive.

This snake has quite the physiognomy of an *Elaps*. The rostral is rather small, and terminates above in an obtuse angle, not extending on the upper surface of the head. The anterior frontals are irregularly quadrangular, half the size of the posterior ones, which extend somewhat on to the loreal region. The

* *Polemon Barthii*, Revue et Mag. Zool. 1858, December, p. 525; and 1859, pl. 5.

vertical is five-sided, with an obtuse anterior and an acute posterior angle, and with the posterior sides longer than any of the others. The occipitals taper posteriorly. The anterior nasal is small and notched by the nostril; the posterior is evidently formed by the united loreal and postnasal shields. One anterior and one posterior ocular. Seven upper labial shields: the first and second are small; the third touches the postnasal, præorbital, and the eye; the fourth below the orbit; the fifth touches the postocular, the sixth the occipital and slightly the postocular, the seventh the temporal: there is another scale-like shield behind the seventh labial, to which, however, the cleft of the mouth does not extend. A single large temporal shield is separated from the postocular by the intervening sixth labial shield. The first pair of the lower labials form a suture together behind the median one; there are two pairs of chin-shields of nearly equal size. The trunk is surrounded on every part by fifteen rows of scales. There are 160 ventral and 44 subcaudal plates, all being entire.

The upper parts are uniform greyish olive, or black after the epidermis is detached. The lower side is uniform yellowish olive, or white if the epidermis is lost.

The total length is 19 inches, the cleft of the mouth being one-third of an inch and the tail 2¾.

The specimen formed part of a collection of West African snakes purchased of Mr. Rich for the British Museum, and containing *Coronella fuliginoides*, *Grayia* triangularis*, *Meizodon regularis*, *Dipsadoboa unicolor*, &c.

Among the best-determined genera of Ophidians are those distinguished by entire subcaudal plates. Out of fifteen genera with which we are at present acquainted possessing this character, no less than five are from Western Africa: namely *Elapops*, belonging to the family Calamaridæ; *Dipsadoboa* (*unicolor*), to the Dipsadidæ; *Holuropholis*, to the Lycodontidæ; and *Atractaspis*, the type of a distinct family, to which perhaps *Polemon*† may belong. This is a very remarkable feature of the Ophidian fauna of Western Africa, in which it appears to be very different from the southern parts of the Ethiopian region, where, according to the present state of our knowledge, but a single snake with the character above mentioned is found, viz. *Atractaspis*

* The name of *Heteronotus* is inadmissible, it being used for a genus of Lizards; see Gray, Catal. Lizards.

† Provided that *Polemon* (of the venomous tooth of which we are not yet informed whether it is externally grooved or perforated by an internal channel) is a genus really different from *Atractaspis*. The genera which have only a part of the subcaudals entire are not brought into the above account.

irregularly; and this is common to Southern and Western Africa.

The last-named genus, *Polemon*, has been lately made known by Prof. Jan in the 'Revue et Magasin de Zool.' 1858, December, p. 525, where he commences an abstract of the MS. of his 'Iconographie descriptive des Ophidiens.' As I have lately paid much attention to this order of animals, I may be allowed to make a few remarks on Prof. Jan's mode of treating his subject. Herpetologists who may refer to his paper will be surprised to find that neither the Collection of the British Museum (which, as well as those of Paris and Leyden, is distinguished for its large series of snakes), nor the publications based on that Collection and published prior to Prof. Jan's labours, are mentioned in it. On this point the following statement will suffice *. Prof. Jan *examined* the specimens on the spot, but after having done so, declared to me that, "if he could not take them to Milan, he would omit them in his work." I thought, nevertheless, the time spent was compensated for by the identification of some synonyms in my Catalogue, and of

* When Professor Jan requested permission to take with him to Milan the type-specimens of the species of snakes which had been described from the Museum specimens, and also some other snakes which were interesting to him, I informed him that it was against the rules of the Museum to allow any such specimens to leave the walls of the Establishment, and that I could not recommend the Trustees to make an exception and accede to his request, as I considered the rule a very proper and sensible one, for the following among other reasons:—

1. It would be very inconvenient to any herpetologist who might come to examine the snakes, to be informed that the specimens which he wished to see were gone to Milan or any other place,—an inconvenience I have myself experienced when I have made an excursion, for the purpose of examining certain type-specimens, to Paris or some other museum where such loan of specimens is permitted.

2. It is very difficult to make sure, even with the very best intention on the part of the person who borrows the specimens, that they will be returned within a reasonable time, if at all. I should like to know, for example, in the present state of Northern Italy, if such a loan would not have been attended with great risk.

3. The manner in which the British Museum is consulted is so different from that of any continental institution, that a rule, such as that of lending specimens, which may not be very objectionable there, where the persons who consult the specimens are few and known, would be very objectionable and impossible here, where any specimen may be asked for at any moment, and expected to be forthcoming.

Being desirous of giving Professor Jan all the assistance in my power, even during my absence, I directed that he should have every facility to examine and make a drawing of any specimen which was interesting to him; and that if he would mark any specimens he might like to have figured, and leave or send an example of the kind of figures he might desire, I would have them made for him as soon as they could be executed, and send them to him for his work.—J. E. Gray.

some which would probably have occurred in his work. So far as omitting all mention of the Collection of the British Museum, Prof. Jan has only kept his word; and it being allowed to everybody to leave his work as incomplete as he pleases, I have no right to interfere with Prof. Jan's proceedings on this point. It is another thing, however, with his method of treating the genus *Elaps*. Being informed by me, during his sojourn at the British Museum, that I had written a paper on *Elaps*, he expressed himself anxious (in a letter directed to me) to receive a copy of it. The publication of this paper (read before the Zoological Society, January 1859) being delayed by the previously intervening vacation of the Society and the execution of the accompanying plates, I communicated to him the distribution of the genus which I had proposed, together with the diagnoses and names of the genera. Now Prof. Jan may have previously arrived at the same results, but he has substituted new names, viz. *Helminthoelaps* for *Callophis* (*Elaps* remains *Elaps*), *Homoroselaps* for *Pœcilophis*, *Homaloselaps* for *Vermicella*. Such a multiplication of synonyms is the less justifiable as the name of *Callophis* has been applied to East Indian *Elaps* since the year 1832, and as there exists a second name for it, *Doliophis**. The denomination of *Vermicella* was introduced into the literature early in 1858.

So far on this point: on a second, I am happy to say, my remarks are directed against a principle in herpetology which appears to have found a rather strong representative in Prof. Jan. He says of the South American *Elaps*, "Les espèces offrent dans leur ensemble, et dans la forme et la position des plaques céphaliques, une telle ressemblance entre elles, qu'il est difficile, pour la plupart, de les distinguer autrement que par les dessins qui résultent de la distribution de leurs différentes couleurs, ordinairement au nombre de trois—le noir, le rouge, et le jaune. *Ces dessins sont assez constants dans les individus de la même espèce.*" That is, as I understand it, "the coloration becomes very constant as soon as you establish for every modification of colour a new species." Certain as it is that there *are* different species of South American *Elaps*, it is equally so that they vary indefinitely in coloration. It is impossible for men who make their observations from preserved specimens to decide in *every* case where is the boundary between variety and species: this will be possible for those only who observe them on their own native ground, and who are better informed as to their localities than we are at present. On the other hand, we know that there are some species of snakes which show an extraordinary tendency to variation in what I call the *ornamental*

* Girard in Proc. Acad. Nat. Sc. Philad. 1857, p. 182.

colours: for instance, *Simotes purpurascens, Tropidonotus quincunciatus, Erythrolamprus venustissimus*, &c. The latter species especially, having the same system of coloration as *Elaps* (with black rings on a red ground-colour), and inhabiting the same parts of the globe, shows a strikingly similar gradation of varieties, but with the physiognomy of the head always precisely the same.

I have again examined the ninety specimens of South American *Elaps* in the Collection of the British Museum, and compared them with Prof. Jan's account. Two only of the species figured by him could be clearly made out, whilst many other specimens approached to some of the figures, and nearly twice as many could not be referred to any of his specific categories. Now, if we consider that there were examined the specimens of a part of the British, German, French, and Italian Collections only, that these specimens were collected in the most accessible parts of South America, that scarcely two specimens perfectly agree with each other, to what amount will the number of species finally reach—species of the geographical distribution of which we know extremely little, which never were observed in nature, and which for the greater part show precisely the same shields of the head! I think the synonymy of some species of snails ought to teach us a different lesson. It would be ridiculous to deny that different species of *Elaps* inhabit the vast continent of Tropical America, and even many more than we at present know; but we can only cautiously introduce *new forms* into the list of *species*; and I think myself at liberty to do so by a combination of the following characters only:—

1. If there is a striking difference in the shape or in the arrangement of the shields of the head. The extent of the sixth upper labial shield (to or not to the occipital) does not constitute a specific difference of itself.

2. If there is a great difference in the general habit of the snake, or in the proportions between the single parts. The number of the ventral and caudal plates is in proportion to the length of the trunk and of the tail. We find that the number of ventral plates in those species of *Elaps* of which we have the best knowledge from a great number of specimens, is subject to a variation of seventy and more; therefore we cannot deduce from it alone a specific character, without having examined several specimens.

3. If there is such a difference in the distribution of the colours that we cannot refer it to a typical coloration of one of the known species*.

Prof. Jan has illustrated the new species with coloured plates.

* Cf. Proc. Zool. Soc. 1859, p. 82.

In specimens which are well preserved, and not for a long period in spirits, we are often able to distinguish the yellow rings from the red ground-colour even if both colours have faded, the former being a more saturated white; in others we can determine the colours by analogy, for there is a certain law in their distribution, in spite of all the modifications; in a few this is quite impossible. Now, if Prof. Jan professes to distinguish the species "par les dessins qui résultent de la distribution de leurs différentes couleurs," one is not prepared to find the coloration of a part of the figures doubtful, or even faulty; nevertheless this is the case.

1. Provided that Prof. Jan ascertained the colours of *E. multifasciatus* from a living specimen, it is very doubtful whether the light rings in this species, three specimens of which are in the British Museum, are red or yellow.

2. If in *E. apiatus*, Jan, the black rings are not yellow-edged, as represented in the figure, the occipital region cannot be yellow, but red, as in *E. Hemprichii* and *affinis*.

3. In *E. Dumerilii* the temporal region is represented as entirely yellow, whilst the black ring round the neck ought to have an anterior yellow margin only, the remainder being red. Inconsistently enough, the same parts in *E. decoratus* are represented as entirely red, whilst in fact the distribution of the colours is the same as in the former species.

4. In *E. Gravenhorstii* the colours are entirely confounded: what is red ought to be yellow, and *vice versâ*, according to the law that the rings within the black zone are always yellow.

With regard to the new species, we find two distinguished from the others by the sixth labial shield extending to the occipital. This appears to be a constant character in *E. decoratus*, which, especially by a very broad vertical shield*, shows that it is a really distinct species. This is not the case in *Elaps Risei*, founded on a single specimen from St. Thomas. The British Museum possesses six specimens—two from Trinidad (one lately arrived), one since ascertained to be from St. Vincent's, and three without proper locality, all of which were and are referred by myself to *E. corallinus*. The sixth upper labial is in two specimens separated from the occipital by a temporal; in two this temporal is united with the labial, both forming one shield in immediate contact with the occipital; in the fifth specimen is a separate temporal on one side and no temporal on the other; and in the sixth there are two temporal shields, but the upper angle of the labial shield touches the occipital: this

* In the figures of *E. decoratus* and *Risei* (Rev. et Mag. Zool. *l. c.*), the sixth labial is represented with a transverse fold. Cf. Proc. Zool. Soc. 1859, pl. viii. f. A.

character therefore cannot of itself constitute a species, much less a subdivision. There are two posterior oculars; and the single postocular of the Milan specimen was accidental, as Prof. Jan rightly supposes. There are seven to eleven black rings round the tail, and seventeen to twenty-eight round the trunk, in the snakes which are ascertained to come from the West Indies. The form of the head-shields being precisely the same as in *E. corallinus*, what other differences hold good? * The black rings are more or less distinctly yellow-edged, which is generally not the case in *E. corallinus*; but then *E. Rüsei* would come into the category of *E. circinalis*, which Prof. Jan does not appear to admit as a species.

I shall now proceed to give the detailed results of the examination to which I have again subjected the specimens in the British Museum, in order to show the vast variability of these snakes, and the degree of possibility of applying to them definitions of such species as may be found in the work of Duméril and Bibron, and in the account of Jan.

First Group.—I begin with those species of *Elaps* in which the black rings are fully developed, without entirely suppressing the red ground-colour, and in which three black rings are always grouped together, including two yellow rings, and thus forming what I call a *zone*. The snakes of this group must be specifically distinct from those of the other, as this system of coloration cannot be a mere modification of that of the latter. Further, there can be no doubt that *E. surinamensis*, Cuv., *E. filiformis*, Gthr., *E. decoratus*, *E. Hemprichii*, Jan, and *E. Dumerilii*, Jan, are specifically different from the long-known *E. lemniscatus*, as they show remarkable differences in general habit or in the shields. Therefore our attention is directed particularly to the latter and its more or less important modifications. I may observe that in all the specimens which I shall mention as having been examined by myself, the shields of the head are precisely the same.

A. The middle black ring is wider than the outer ones, but less than twice as wide.

I. The intervening spaces of the red ground-colour are wider than the middle black ring.

1. A white cross-band before the eyes = *E. lemniscatus*, D. & B.

α. A yellow ring is wider than one-half of an outer black one; a single zone round the tail.

a. Six zones round the trunk; ventrals 236, caudals 21.—One specimen.

b. Seven zones round the trunk; ventrals 224, caudals 28.—One specimen from Pernambuco.

c. Eight zones round the trunk; ventrals 234, caudals 27.—Two specimens from Brazil.

d. Nine zones round the trunk; ventrals 238, caudals 24.—One specimen from Bahia.

e. Ten zones round the trunk; ventrals 228, caudals 26.—Two specimens from Bahia.

β. A yellow ring is half as wide as an outer black one; one zone and a half round the tail.

a. Nine zones round the trunk; ventrals 231, caudals 34.—One specimen from the West Indies.

b. Ten zones round the trunk; ventrals 220, caudals 36.—One specimen.

c. Ten zones round the trunk; ventrals 245, caudals 33.—One specimen from Trinidad.

d. Fourteen zones round the trunk; ventrals 262, caudals 30.—One specimen from Brazil.

2. No white cross-band before the eyes.

α. Nasal separated from the præocular by the third labial shield: *E. Gravenhorstii*, Jan, founded on a single specimen from Brazil; it is described as having the middle black ring twice as wide as an outer one, but the figure represents it narrower.

β. Nasal in immediate contact with the præocular.

a. The black rings not confluent on the belly.

αα. Shields of the muzzle and of the crown black, anteriorly margined with yellow; thirteen zones round the body, one round the tail.—One specimen from the Argentine Republic.

ββ. Muzzle and crown entirely black: *E. Margravii*, D. & B.

b. The black rings of every zone confluent on the belly, and the yellow rings spotted with black.

αα. Ten zones round the trunk, and one or one and a half round the tail; ventrals 230, caudals 22–24.—Two specimens from Brazil.

ββ. Twelve zones round the trunk and one round the tail; ventrals 232, caudals 20.—One specimen from Brazil.

3. Muzzle entirely white: *E. frontalis*, D. & B.

II. The intervening spaces of the red ground-colour are equal in width to the middle black ring: *E. Tschudii*, Jan.

III. The intervening spaces of the red ground-colour are narrower than the middle black ring; a white band before the eyes.

1. Ten zones round the trunk; ventrals 221, caudals 36.—One specimen.

2. Eleven zones round the trunk; ventrals 240, caudals 39.—One specimen.

B. The three black rings of each zone equal in width to one another.

I. No white band before the eyes: ? *E. Margravii*, D. & B. part.

1. Black rings not confluent on the belly.

a. Eight zones and a half round the body, one half round the tail; ventrals 222, caudals 22.—One specimen from River Capin (Para).

b. Twelve zones round the body, one round the tail; ventrals 228, caudals 23.—Two specimens from Caraccas.

2. Black rings confluent on the belly, a yellow band behind the eyes; ventrals 199–213, caudals 29–37: *E. elegans*, Jan, from Mexico.

II. A white band before the eyes.

1. The yellow rings are narrower than the black ones; thirteen zones round the trunk, one and a half round the tail.—One specimen.

2. The yellow rings are broader than the black ones; ten zones round the trunk, one round the tail.—One specimen from St. Vincent's,

which I consider as a variety of *E. corallinus* (*E. Riisei*), where the rings exceptionally approach a triple arrangement.

All these different forms are viewed by myself as varieties of *Elaps lemniscatus*, L., as long as no other constant differences in the shields of the head, &c. are pointed out, with the exception perhaps of *E. Gravenhorstii*, known from a single specimen only, and of the last form mentioned, referred to *E. corallinus*.

The Second Group comprises those forms in which the black rings are equidistant, and if fully developed, do not entirely suppress the red ground-colour: some have the black rings edged with yellow; in others this colour appears to be absent. The group certainly contains several species, among which the most northern one is pretty well determined, also with regard to its geographical range: but there is a very great variation among the more southern ones; and which of them are such as to admit of a specific distinction, I attempt to show by the following examination and comparison of the British Museum specimens with the descriptions of different authors. *Nearly the whole group has been comprised by Schlegel under one species,* E. corallinus.

A. The red interspaces are spotted with black (besides the black tip of each scale).

I. Black rings edged with yellow.

a. The interspaces of the red ground-colour extend over ten to twenty scales.

α. The black rings rudimentary, gradually becoming complete and surrounding the body.

aa. Ten round black spots along the back and three rings round the tail: *E. epistema*, D. & B., from Mexico.

bb. Black bands irregularly interrupted, separated by ten to fourteen red scales; ventrals 216, caudals 40: *E. affinis*, Jan, from Mexico.

cc. Black bands interrupted on the sides, separated by sixteen red scales; thirteen round the trunk and five round the tail; ventrals 204, caudals 40.—One specimen from Mexico.

β. The black rings complete: *E. fulvius*, D. & B.

dd. Black bands separated by sixteen red scales, twelve round the trunk and five round the tail; ventrals 217, caudals 36.—Four specimens from Mexico.

ee. Black bands separated by fifteen red scales, eleven round the trunk and four round the tail; ventrals 213, caudals 41.—One specimen from California.

ff. Black bands separated by thirteen red scales, twelve or thirteen round the trunk and four or three round the tail; ventrals 216, caudals 33.—Four specimens from Mexico.

gg. Black bands separated by thirteen red scales, thirteen round the trunk and two round the tail; ventrals 224–237, caudals 26–38: =*E. tener*, Baird, from Texas.

hh. Black bands separated by twelve red scales, thirteen round the trunk and four round the tail; ventrals 222, caudals 42.—One specimen from Texas.

ii. Black bands separated by eleven red scales, fifteen round the trunk

and five round the tail; ventrals 213, caudals 41.—One specimen from North America.

kk. Black bands separated by eleven red scales, twelve round the trunk and five round the tail.—One specimen.

b. The interspaces of the red ground-colour extend over less than ten scales.

ll. Black bands separated by nine red scales, fourteen round the trunk and four round the tail; ventrals 213, caudals 41.—One specimen.

mm. Black bands separated by eight red scales, twenty-three round the trunk and six round the tail.—One specimen.

nn. Black bands separated by seven red scales, twenty-three or twenty-four round the trunk, and seven or six round the tail; ventrals 220, caudals 55.—Two specimens from Honduras.

II. The black rings without visible yellow edge.

a. The red interspaces are irregularly spotted with black; thirty-one black rings round the trunk, and eight round the tail: *Elaps apiatus*, Jan, from Vera Cruz.

b. A black cross, formed by four scales, in the dorsal centre of every red interspace; twenty-eight black rings round the trunk, and five round the tail.—One specimen from Mexico.

B. The red interspaces have no black spots besides the black tip of each scale.

I. Crown of the head (posterior portion of the occipital shields) white.

a. The interspaces between the black rings extend over seventeen scales; the width of a black ring is one-half of that of the red and yellow together; ten black rings round the body, and four round the tail. —Two specimens.

b. The interspaces between the black rings extend over eight to ten scales; the width of a black ring is one-fourth of that of the red and yellow together.

α. Nineteen black rings round the body, and four round the tail.—One specimen, perhaps = *Elaps diastema*, D. & B.

β. Twenty-three black rings round the trunk, and six round the tail; ventrals 228, caudals 40.—Two specimens.

c. The interspaces between the black rings extend over four to six scales; the width of a black ring is more than one-half of that of the red and yellow together; nineteen to twenty-one black rings round the trunk, and six round the tail; ventrals 222, caudals 55.—*Elaps Fitzingeri*, Jan, from Mexico.

d. The interspaces between the black rings extend over two to three scales, and

α, are broader on the belly.

aa. Thirty-nine to forty-five black rings round the trunk, two or three round the tail; ventrals 241, caudals 28.—Three specimens from Venezuela.

bb. Sixty-five black rings: *Elaps mipartitus*, D. & B., from New Granada and Cayenne (*Elaps decussatus*).

β. The interspaces are equal in width, superiorly and inferiorly; fifty-seven black rings round the trunk, and three round the tail; ventrals 278, caudals 24: *Elaps multifasciatus*, Jan, from Central America.

II. Crown of the head black.

a. The yellow rings are very distinct; the red ground-colour has generally a brown or brownish hue.

α. The width of the black rings is less than one-half of that of the interspaces between: *Elaps circinalis*, D. & B.

aa. The sixth upper labial in contact with the occipital : *E. Rüsei*, Jan.

αα. Twenty-six to twenty-eight black rings round the trunk, and seven or eight round the tail; ventrals 212, caudals 32.—Two specimens.

ββ. Twenty-five black rings round the trunk, and eleven round the tail; ventrals 184, caudals 45.—One specimen from St. Vincent's.

γγ. Twenty-two black rings round the trunk, and eight round the tail; ventrals 176, caudals 45.—One specimen from Trinidad.

bb. A separate temporal shield between the sixth upper labial and the occipital.

αα. Thirty-one black rings round the trunk, and seven round the tail; ventrals 210, caudals 31.—One specimen from the West Indies.

ββ. Seventeen black rings round the trunk, and six round the tail; ventrals 207, caudals 42.—One specimen.

β. The width of the black rings is more than one-half of that of the interspaces between.

aa. Twenty-eight black rings round the trunk, and ten round the tail; ventrals 202, caudals 47.—One specimen from Brazil.

bb. Twenty-eight black rings round the trunk, and six round the tail; ventrals 210, caudals 32.—One specimen.

cc. Twenty-five black rings round the trunk, and six round the tail; ventrals 214, caudals 34.—One specimen.

dd. Twenty-four black rings round the trunk, and eight round the tail; ventrals 210, caudals 31.—One specimen.

γ. The black rings and the interspaces between nearly equal in width; each black ring edged with a single series of isolated yellow scales anteriorly and posteriorly.

aa. Thirty-two black rings round the trunk, and nine round the tail; ventrals 109 (209?), caudals 47 : *Elaps ornatissimus*, Jan, from Central America.

bb. Forty-two black rings round the trunk, and ten round the tail; ventrals 206, caudals 43.—One specimen from Para.

b. The yellow rings indistinct or not visible.

α. The interspaces of the red ground-colour extend over ten to thirteen scales : *Elaps corallinus*, D. & B.

aa. Over thirteen scales; seventeen black rings round the trunk, and six round the tail.—One specimen from Trinidad.

bb. Over twelve scales.

αα. Fifteen black rings round the trunk, and six round the tail; ventrals 194, caudals 43.—One specimen from the interior of Brazil.

ββ. Nineteen black rings round the trunk, and four round the tail; ventrals 221, caudals 30.—One specimen.

cc. Over eleven scales; eighteen black rings round the trunk, and five round the tail.—One specimen.

dd. Over ten scales; twenty to nineteen black rings round the trunk, and seven to eight round the tail.—Two specimens from Brazil.

β. The interspaces of the red ground-colour extend over less than ten scales.

ee. Over nine scales.

αα. Eighteen black rings round the trunk, and four round the tail; ventrals 215, caudals 28.—One specimen.

ββ. Eighteen black rings round the trunk, and seven round the tail.—One specimen.

γγ. Twenty-one black rings round the trunk, and five round the tail; ventrals 211, caudals 30.—Two specimens from Brasil.

ff. Over eight scales.

αα. Twenty black rings round the trunk, and four round the tail; ventrals 201, caudals 28.—One specimen.

ββ. Thirty-one black rings round the trunk, and seven round the tail; ventrals 201, caudals 32.—One specimen from Trinidad.

gg. Over seven scales; twenty-two black rings round the trunk, and ten round the tail.—One specimen.

hh. Over six scales.

αα. Thirty-three black rings round the trunk, and seven round the tail; ventrals 201, caudals 32.—One specimen.

ββ. Thirty black rings round the trunk, and seven round the tail.—Three specimens.

γγ. Twenty-nine black rings round the trunk, and ten round the tail; ventrals 190, caudals 43.—One specimen from the West Indies.

We can distinguish, among these numerous variations, two forms: the northern, with the black rings edged with yellow, the red ground-colour maculated with black, and a yellow occiput—*E. fulvius*; and the southern, without yellow rings, without black spots, and with black occiput—*E. corallinus*. But Schlegel had good reason for not even admitting these two species, because there occur a great many forms which we are at a loss to refer to either of the two, and which we shall be justified in raising to species if we shall have determined their geographical extent and their constancy of character by more than a single specimen. It appears to be perfectly evident, from the synopsis given above, that *E. affinis*, Jan, and *E. epistema*, D. & B., founded on single specimens, are merely varieties of *E. fulvius*. In this snake the bands *gradually* become fewer in number; they are regularly interrupted on the sides; they are irregularly interrupted (*E. affinis*), and finally are reduced to mere spots (*E. epistema*). It is, however, remarkable that all these specimens come from Mexico. As long as I could not establish the above series, I held *E. epistema* for a good species. *E. affinis* is represented by Prof. Jan without any yellow; but this appears to me rather doubtful.

E. tener, discovered by Prof. Baird, from Texas, may probably prove to be a good species, distinguished by a remarkably short tail and a comparatively slender body. More doubtful are *E. apiatus*, Jan; a specimen in the British Museum, closely allied to it (A. II. *b*), which I leave for the present as *E. corallinus*, var.; and *E. Fitzingeri*, Jan.

The division which I have placed under B. I. *d*, comprising those specimens in which a great number of black rings nearly suppress the ground-colour, the individuals of *which are of much smaller size and of a comparatively slenderer body*, is specifically

different from all the others: it comprises *E. mipartitus*, D. & B., *E. decussatus*, D. & B., *E. multifasciatus*, Jan, together with three specimens in the British Museum. The specific distinction of *E. multifasciatus* and *mipartitus* is not yet clearly pointed out; and the British Museum specimens do not completely agree with either, having a white band before the eyes, which peculiarity, however, in my opinion, cannot constitute of itself a specific character, as it is difficult to perceive why a modified extent of the black coloration of the head should be considered as more important than that of the trunk.

With regard to the remainder (B. II.), comprising *E. corallinus*, D. & B., *E. circinalis*, D. & B., *E. Rüsei*, Jan, *E. ornatissimus*, Jan, I consider them as one and the same species. Even if further observations should point out a specific difference between the *E. corallinus* from the West Indies and the continental coast nearest to those islands, and between the *E. corallinus* from the neotropical continent, this difference is not to be found in the sixth upper labial shield, as I have proved above, and the name of *E. Rüsei* must be considered as a synonym for an accidental form of *E. circinalis*, D. & B.

I can hardly give any opinion on *E. alternans* and *E. gastrodelus*, D. & B., perfectly unknown to me, and not admitted in the list of species by Prof. Jan. *E. Langsdorfii*, Wagl., is known to me also only by the very short note given on it by Prof. Jan. The discovery that *E. calligaster*, Wiegm. and *E. collaris*, Schleg., really are South American species, will be gratefully received by every herpetologist, the character of the East Indian *Elaps*, "*corpore vittato*," as given by Wagler, thus being undisturbed; but it is rather strange that specimens belonging to those species should be marked, both in the British and in the Paris Museum, as coming from the Philippines.

The list of South American species and varieties of *Elaps* will now be as follows:—

1. *Elaps corallinus*, L., with the varieties:
    - *a. E. psyche*, Daud.
    - *b. E. circinalis*, D. & B.
    - *c. E. Rüsei*, Jan.
    - *d. E. ornatissimus*, Jan.
2. *Elaps mipartitus*, D. & B., with the varieties:
    - *a. E. decussatus*, D. & B.
    - ? *b. E. multifasciatus*, Jan.
3. *Elaps Langsdorfii*, Wagl.
4. *Elaps fulvius*, L., with the varieties:
    - *a. E. tristis*, Baird and Girard.
    - *b. E. epistema*, D. & B.
    - *c. E. affinis*, Jan.
5. *Elaps tener*, Baird and Girard.
6. *Elaps bipunctiger*, D. & B.
7. *Elaps surinamensis*, Cuv.
8. *Elaps lemniscatus*, L., with the varieties:
    - *a. E. Margravii*, D. & B.
    - *b. E. frontalis*, D. B.
    - *c. E. elegans*, Jan.
    - *d. E. Tschudii*, Jan.
9. *Elaps filiformis*, Gthr.
10. *Elaps decoratus*, Jan.
11. *Elaps Dumerilii*, Jan.
12. *Elaps Hemprichii*, Jan.

Doubtful species are—

13. *Elaps gastrodelus*, D. & B.
14. *Elaps diastema*, D. & B.
15. *Elaps zonatus*, Hallowell.
16. *Elaps divaricatus*, Hallowell.
17. *Elaps apiatus*, Jan.
18. *Elaps Fitzingeri*, Jan.
19. *Elaps Gravenhorstii*, Jan
20. *Elaps alternans*, D. & B.

XVII.—*Remarks on* Professor Allman's "*Notes on the Hydroid Zoophytes.*" By T. Strethill Wright, M.D.

In the Number of the 'Annals and Magazine of Natural History' for July 1859, is contained a description of three Zoophytes by Professor Allman which have previously been described by myself.

1. *Manicella fusca* (Allman), *Bimeria vestita* (mihi).

After describing this Zoophyte, Professor Allman states, "I have not been able to find any description of the present animal, though Dr. S. Wright informed me last year that he had met with a Tubularian Zoophyte in which the greater part of the polype was covered by the polypary."

This Zoophyte was discovered by myself in August (1858), soon after which time I gave an account of it in a letter to Mr. Joshua Alder. In October following I mentioned it and its locality to Professor Allman,—the same locality in which he found it last spring. On the 26th of January last, I described it, with figures, to the Royal Physical Society of Edinburgh; and it appeared in full in the report of the Society's Proceedings contained in the 'Witness' of the 16th of February, in which paper, under the editorship of the late Hugh Miller and since his death, the "Proceedings of the Royal Physical Society" have been regularly reported for some years. Finally, I have described the animal, with figures, in the 'Edin. New Phil. Journal' for July last. I am at a loss to account for Professor Allman's inability to find a description of *Bimeria vestita*, as an application to its discoverer would have removed every difficulty.

Professor Allman errs in stating that the *polypary* (the polypidom or corallum of other writers) covers the body of the polype and one-half the tentacles. The covering of the polype in *Bimeria* consists of the "colletoderm*," which in this species is

* I have formerly given the term "colletoderm" (κολλητὴς, *glutinator*) to a glutinous secretion which forms a covering to the hard corallum of zoophytes. In the *Corynes* it is readily seen on the tips of the growing shoots of the polypary, which are cemented by it to the surfaces over which they creep. It also forms the gelatinous marsupial sacs which surmount the female reproductive capsules of *Laomedea lacerata*, *Sertularia pumila*, &c., and in which the ova undergo their first metamorphosis. It

largely developed and thickened with mud, &c. In some of my specimens, which have been kept in dilute alcohol, the mud is removed, and the colletoderm appears as a transparent structureless coat covering the polypes and the corallum, and quite distinct from the latter. I have detected this membrane also on the body of the polype of *Coryne decipiens* (Dujardin) and *Clava repens* (mihi), so that *Bimeria* is not singular amongst Zoophytes in the possession of an overcoat.

2. *Eudendrium bacciferum* (Allman), *Garveia nutans* (mihi).

This Zoophyte was also described and figured by me before the Royal Physical Society, in the 'Witness,' and in the 'Edin. New Phil. Journal,' under the same dates as *Bimeria vestita*.

3. *Coryne Briareus* (Allman), *Coryne implexa* (mihi), *Tubularia implexa* (Alder).

The corallum, destitute of polypes, of *Coryne implexa* was described by Mr. Alder, in his Catalogue of Zoophytes of the Northumberland Coast, under the title of *Tubularia implexa*. In August 1859 I found it with its polypes, and described and published it together with *Bimeria vestita*. I have, since the publication of *C. Briareus* by Professor Allman, placed my specimen of *C. implexa* in the latter gentleman's hands; and he is of opinion that it is identical with his. He has, however, unfortunately lost his specimen; so that the coralla cannot be compared with each other. The corallum of *C. implexa* is composed of two very distinct coats, the inner one ringed and horny, the outer one thin, membranous, and not ringed. The latter appears to consist of "colletoderm" in an indurated state.

All the above-mentioned Zoophytes exist in the same localities —the Bimer and Garvey Rocks at Queensferry, Firth of Forth.

Edinburgh, August 1, 1859.

XVIII.—*On the Laws of Evolution of the Organic World during the Formation of the Crust of the Earth.* By H. G. Bronn.

[Concluded from p. 90.]

III. *Results concerning the relations which connect the present state of the organized kingdom with its geological states.*

In all that precedes, we have taken into consideration not only the ancient, but also the present state of things. We have traced the modifications presented to us by the organic world in

is very indestructible, and not coagulable by dilute spirit. It is secreted directly from the ectoderm of the zoophyte, the hard corallum being afterwards secreted beneath it. It is probably a modification of chitine.

the ancient periods, not only to the threshold of the present creation, but also into its very heart. We have seen that these modifications do not by any means all cease at the threshold of existing nature, but that they often continue their course without interruption, so that it becomes difficult for us to say exactly where this threshold is to be found. The groups of plants or animals which were in course of rapid diminution at the close of the geological ages have continued diminishing in the existing epoch: amongst all the fossil species the marine Mollusca are those with which we are best acquainted, and the study of which is most decisive upon this point. Those, on the contrary, which were in course of augmentation have continued their development. At first there existed a certain number of orders and suborders entirely foreign to our existing creation; and all the genera, with the exception of from 1 to 3 per cent., were different from those of the present day. By degrees the number of these foreign types diminished, and the number of genera which have persisted to our days became more and more considerable. In the sequence of ages this number rose gradually from 20 to 40, 60, 80, 90, and, lastly, 100 per cent. By degrees, and this even at the close of the Cretaceous period, some isolated species made their appearance, which have persisted to the present day. Starting from the Eocene period, their number rose gradually to 20, 60, 80, 90, 95, and 99 per cent., although it is not yet possible to demonstrate an equally regular gradation for all the classes. But however gradual may have been this passage from the geological faunas and floras to existing nature in the south of Europe (according to Philippi), it is very possible that in other countries a great portion of the series of intermediate beds may be wanting, and that consequently in these regions the distinction between the marine formations belonging to these two periods may appear far more marked than in Europe. In the same way, the separation of two older formations may be far more distinctly marked in one country than in another, for perfectly analogous reasons. This gradual passage from the ancient creations to the existing one does not manifest itself solely in the constantly increasing proportion of identical species, but also in the constantly increasing differentiation of the floras and faunas in accordance with zones, from the Eocene period to the present day. The formation of local floras and faunas, from the Eocene epoch to the Pliocene and Diluvian epochs, exhibited the same local characters as the floras and faunas of the present day: already each country was inhabited by the same characteristic families, the same genera, and a great part of the species which we find dwelling there at present. The most recent tertiary strata of England contain a testaceous

fauna which agrees especially with that of the Northern Ocean; the fauna of these same strata in Italy finds its congener in the existing fauna of the Mediterranean; in the West Indies we find the fauna of the existing sea agreeing for the most part with the tertiary fauna of the most recent of the islands. The bone-caves of Europe and the north of Asia are especially rich in remains of bears, hyænas, oxen, deer, and elephants,—that is to say, genera, species of which (although generally distinct from the diluvian species) still live for the most part in the same countries. In the caverns of South America we find the remains of Platyrrhine Quadrumana and of Edentata predominating, and even, as regards the latter, remains belonging to genera which still exist in that country, or which are very nearly allied to existing genera; some species even are identical. In the bone-caves of Australia, lastly, only bones of Marsupials have been found; and we know that at the present day we scarcely find any Mammalia on that continent which do not belong to the Marsupial division. One of the most remarkable proofs of the gradual passage from one period to the other is derived from the study of the ancient forests of *Taxodium distichum* in Louisiana (which, however, have for the most part existed in the present epoch).

The appearance of Dicotyledonous vegetation at the close* of the Cretaceous and commencement of the Tertiary period has been repeatedly represented as an event of immense importance for the development of the whole terrestrial fauna. Its importance is, in fact, incalculable in comparison with the characters to which we are compelled to have recourse in order to separate the Tertiary from the present period, and which are of so subordinate a nature. Thus one is often tempted to throw back the limits of the most recent period to this moment, and to confound the tertiary and recent strata in a single common period. In fact, in order to distinguish the Tertiary period from the actual epoch, we are forced to have recourse to one or other of the three following events, which probably indeed followed each other very closely, but which we cannot show to have been synchronic:—

1. The last appearance of existing plants and animals;
2. The last extinction of ancient species without the intervention of man;
3. The appearance of man himself.

The date of these three events can only be determined by the investigation of the fossil remains which come to our knowledge.

* Not only in the Upper Chalk of Germany have *Credneriæ*, &c., been found, but the *Lower* Cretaceous beds of Aix-la-Chapelle have yielded numerous leaves of Angiosperms.—Ed. *Annals*.

But this is a difficult theory; for the results of our investigations in this direction can never be regarded as definitive, besides that in this case we have probably to do only with very small chronological differences.

The marine Pliocene beds also contain species of Mollusca foreign to the previous periods (see Philippi, Wood, and D'Orbigny), united with others which already existed in the Miocene period; these have consequently made their appearance in the course of the Pliocene epoch. The lacustrine Diluvian beds present analogous facts as regards the terrestrial Mammalia. Bones identical with Diluvian remains have been found in the sub-Apennine Miocene sands and in the Mammaliferous crag of England. But no one has yet succeeded (and perhaps no one ever will succeed, from the want of constant characters) in determining at what point in the Pliocene strata these latter species appeared.

With the close of the Pliocene and Diluvian formations, the last animal and vegetable species which became extinct, independently of the action of man, disappeared; for in the strata of alluvium we only meet with the remains of species still actually in existence. It may, however, be objected to this view that, in the most recent Pliocene strata, the number of extinct species only reaching a very small per-centage, the determination of the age must become very uncertain, owing to the organic remains not being abundant. In fact, in this case it may easily happen that the rare extinct species have not been preserved in the locality under examination, although they may have been in others. We consequently run the risk of regarding as alluvium, strata which are in fact Diluvian or Pliocene, and of employing as a proof, the very point which we have to demonstrate. We are by no means sure that such errors have not been committed in cases which have been employed to decide the question. Lastly, how can we believe, after all the facts above cited, that the last 5, 4, 3, or 2 per cent. of the extinct species of the Pliocene population ceased their existence at the same moment under the equator and at the pole, at the bottom of the ocean and on the surface of the continents?

This is a question as difficult to settle, as to know whether man existed simultaneously with extinct species which have ceased to exist without any historical intervention on his part, or whether he has only appeared after their extinction. The appearance of man, who has had so great an influence upon the present state of our planet and upon the whole development of nature—the entry upon the scene of the world of this "lord of the creation," for whose reception all the rest could only have been a preparatory work, is an event which one would willingly have taken as the starting-point of a new era in the history of the world. It is true that human bones and fragments of artificial objects have

frequently been found mixed with the remains of Diluvian animals: but it has been thought that these facts could be got over by the hypothesis that these bones were not in primitive relations of association, but had been brought together at a subsequent epoch by currents of water; or, at least, it has been objected that the nullity of such a hypothesis cannot be demonstrated. Sir Charles Lyell in particular has endeavoured to explain the juxtaposition of human bones with Diluvian remains observed in Louisiana by Dickeson, by means of the disintegration of beds of clay in consequence of subterraneous erosions in a locality where Indian graves existed above Diluvian remains. The following observations would be more difficult to refute, if they had been surrounded by all the necessary guarantees. In a bone-cave in Brazil, M. Lund found a skull similar to that of the present aborigines, together with other human bones, amongst bones of *Platonyx* and *Chlamydotherium*. All the remains were petrified in the same way, penetrated by perfectly similar ferruginous incrustations, and presented the same metallic fracture. Out of twenty-four bone-caves in Brazil, M. Lund states that in six he found human bones associated with the remains of extinct animals; and although these observations could not be regarded in the light of absolute proof, M. Lund was inclined to think that these men and these animals had lived at the same time.

We must also mention here the juxtaposition of human bones, fragments of pottery, and other artificial products, with remains of extinct mammalia in the clay and osseous breccia of Bize, near Narbonne, according to Marcel de Serres, Tournal, and Lecoq; the analogous observations of M. Schmerling in the bone-caves of Louvain; those of M. Marcel de Serres in the caves of Mialet; the discoveries of the same nature in the recent volcanic matters of La Denise, near the Puy in Auvergne; and especially those of the rock-clefts of the Würtemberg Alb, in which five human molars have been found in the deepest parts, and in a state of fossilization identical with that of the bones of *Hippotherium*, *Tapirus*, and *Mastodon* found beside them,—facts which are guaranteed by Jaeger, Kurr, and Quenstedt. One circumstance alone might give rise to some scruples—namely, that these five teeth are all identical in form, and that, although they correspond with the last molar of the lower jaw (in the Mongols, the Finns, and the Negroes), they present a greater resemblance to each other than to this tooth*.

All the cases just cited are of such a nature, that a person destitute of any preconceived opinion would adopt without hesitation the notion of the simultaneous existence of human bones and

* See also Mr. Prestwich's paper at p. 230 of our present Number.—Ed. *Annals*.

remains of fossil animals in the same strata. Nevertheless any one who chooses to submit them to the most severe criticism may still leave the door open for certain doubts.

It is therefore useless, in our opinion, to speak of those cases in which the pretended discovery of human bones, going back to the Diluvian epoch, or even to a still more ancient period, has been completely refuted. Nor shall we dwell upon the traditions which are preserved by the inhabitants of New Zealand and Madagascar with regard to the existence of gigantic birds, such as the Moa (*Dinornis*) and the *Æpyornis* in remote countries—birds of which we now find the eggs and bones in strata of very recent origin; for it is very possible that these traditions repose merely upon the existence of these fossil remains, and in any case they are not supported by sufficient proofs*.

Nevertheless all these facts, although they do not prove irrefragably the coexistence of man with species of animals now extinct, certainly deserve serious consideration. If, in the present state of science, we collate them with the discovery mentioned in this work, of the skull of an Indian at a great depth in the Cypress-deposits of Louisiana†, we cannot but see that it

* In the case of the Moa, Mr. W. Mantell's late observations support the statements as to the cotemporaneity of man with this great bird.—Ed. *Annals*.

† The author alludes to the following facts. Messrs. Dickeson and Brown have discovered in Louisiana a deposit of fossil Cypress-trunks (*Cupressus disticha*, Linn., *Taxodium distichum*, Rich.) belonging to the same species which still exists in the regions exposed to the inundations of the Mississippi. This deposit is formed of ten layers of Cypresses, arranged vertically one above the other, and separated by layers of earth. Ten trunks of great diameter have been met with, for each of which the counting of the woody layers of growth gave a duration of about 5700 years. Above the most recent of these Cypress-beds there now grows a forest of evergreen Oaks, the age of which is estimated at 1500 years. Mr. Dowler (Jameson's Journal, 1854, lvii. pp. 374, 375) takes these facts as the basis of the following chronological calculations. The soil formed by the alluvia of the river originally produced only herbage; it was a vast bog with a moving soil. It was only by degrees, when the soil had been elevated and become more solid, that the Cypress-forests could establish themselves upon it. We know (thanks to the ancient data of Strabo) that the Nile, in the space of seventeen centuries, has only elevated the soil of Egypt, by its deposits of alluvium, at the rate of five feet in a century. Adopting a similar standard of measurement, we should have to suppose that it was only at the end of 1500 years that the soil of the moving bog became sufficiently firm to support Cypresses. Now, if we consider that some of the Cypresses which we find in this fossil forest attained the very great age of 5700 years, and if we pay attention to the fact that, for each of the ten layers of the deposit, we are compelled to assume generations of Cypresses succeeding one another, perhaps in great number, to be afterwards thrown down and left to decompose before the period at which the trees still actually living were developed, we shall not be charged with exaggeration in calculating for the duration of the deposition of each bed

is very difficult to establish a clearly-marked line of demarcation between the Tertiary epoch and the present.

New Results.

In 1848 and 1849, we had already indicated, in the 'Index Palæontologicus' (second part, pp. 746–913), several of the results contained in the present work with regard to the appearance of organisms on the surface of the earth, but without

a period of time answering at least to two generations of Cypresses. We see therefore that each of the forests which gave origin to the formation of one of the beds of this deposit lasted at least 11,400 years, before, being buried in the soil, there was a fresh irruption of the waters and formation of a new bog. The marshy soil of this new bog became solidified in its turn, and enabled to produce a new forest of Cypresses, the duration of which was not inferior to that of the former. Then this forest was buried in its turn, and the same phænomenon was repeated ten times in succession. For the last of these alternations, therefore, calculation gives the following result:—

Formation and solidification of the bog	1,500 years.
Duration of two generations of Cypress	11,400 „
Duration of the existing forest of Oaks after the drying and elevation of the soil..	1,500 „
	14,400 „

The first nine times there was no desiccation and elevation of the soil after the development of the forests of Cypress, and the production of intermediate oak-forests was not possible. But as the depressions of the soil which terminated the existence of each forest of Cypress often produced a depression of the surface far below the level of the original bog, we may without much chance of error retain this space of 1500 years for each of the ten preceding periods, and we find then that the formation of the entire deposit required a period of time equal to 11 × 14,400, that is to say, 158,400 years; and during the whole of this immense period, the vegetation of the country has for the most part retained the same characters! At New Orleans, at 16 feet below the soil, in the fourth of these beds from the surface, there has been found a well-preserved human skull, corresponding perfectly in its form with the skulls of the actual aborigines of America, and accompanied by the remains of burnt wood. From this we must conclude that this country was inhabited 57,600 years (4 × 14,400) ago by men of the American race.

Such is Mr. Dowler's calculation. It is true that several elements of this calculation are somewhat hypothetical; but the facts suffice to show, with very great probability, the immense duration of an epoch posterior to the Diluvian period, at least if we do not choose to regard the strata below the human skull as still belonging to the cænolithic age—an opinion which does not appear to be supported by local observation in Louisiana. Moreover, it is worth while to remark that this Cypress (*Taxodium distichum*), upon which it would appear that we may rest, in order to demonstrate the long duration of the post-diluvian epoch, is one of the three species the existence of which may be traced, according to M. Göppert, upon the soil of Europe, from the upper Miocene to the actual epoch (under the name of *Taxodites dubius*).—E. Claparède.

representing these facts as flowing from a positive law—as resulting from a common cause. Even then we pointed out the passage of species from one bed to another, the variability of the duration of their existence, and the increase in the number of species, genera, orders, and classes in recent periods,—circumstances which support the idea of the existence of a hotter and more uniform climate in the ancient periods. Even then we indicated the progressive advance to perfection of the different subkingdoms by the successive appearance of more perfect groups and the extinction of other groups of inferior organization, and the influence of the external conditions of existence upon the successive appearance of the various types of animals and vegetables upon the surface of the earth,—understanding by these external conditions, atmospheric conditions and those of configuration of soil or the action of other organized beings. Before 1848, these different points of view had never been carefully studied in detail; and those which, like the gradual development of creation from more simple to more complex organization, had been the object of special investigations on the part of other authors, appeared to lead to results agreeing but little with older knowledge. The conclusions at which we arrived in the 'Index Palæontologicus' remain true now as then. Recent researches confirm them in all points.

Nevertheless the present work is rich in new results. It places the law of adaptation of the successive faunas and floras to the external conditions of existence, as a fundamental law which governs all the others. Considered on its negative side, this law is absolute, and excludes every phænomenon which would contradict it; but considered on its positive side, it allows free play to other laws subordinated to or independent of it. This work shows us the necessity of the simultaneous appearance of plants and animals, and teaches us that all the phænomena resulting from this fundamental law flow from it in a necessary and direct manner. It consequently confirms, by palæontological proofs, the geological theory in favour at the present day. By positive and incontestable facts, it overthrows the old idea of distinct faunas and floras confined within perfectly limited strata, determined by lithological limits remaining the same over all the surface of the globe. It demonstrates the inequality of duration of species coexisting in the same stratum. It presents the law of terripetal evolution as an expression of the gradual transformation of the surface of the globe and of its influence upon the totality of the successive characters of the floras and faunas. It establishes the second fundamental law, namely, that of progressive development (advancing in concert with the progression which might result simply from the terripetal law).

It exhibits in detail and in a decisive manner the importance of the appearance of the angiospermous Dicotyledons as a condition of existence for the whole terrestrial fauna. Lastly, it indicates the importance of the synchronic relations which existed between the ascertained depressions of the soil, combined with the emanation of a great quantity of carbonic acid eliminated immediately by the formation of coal, and the existence of the singular forests of *Stigmaria*, connected with a vegetation composed only of vascular Cryptogamia and gymnospermous Dicotyledons, to the exclusion of the Angiospermia*. These peculiar conditions of vegetation seem to have made their appearance again, although with a very local development, in the course of the Jurassic period. We are convinced that the office of these forests was to maintain the atmosphere in a respirable state at a period when carbonic acid was emitted in greater abundance than at the present day, and even to render it more suitable for respiration, although positive proofs of this are wanting. An abundant vertebrate fauna with an active respiration would in course of time have acted injuriously in the opposite direction. If this opinion should be confirmed, the fact of the progressive development of the vegetable kingdom would enter, at least partially, into dependence upon the law of adaptation of the successive creations to the external conditions of existence. By this the unity of the laws and phænomena could not but gain.

The results at which we have arrived rest upon the actual state of our knowledge of the fossil world. New discoveries may therefore at any time introduce modifications of them. Nevertheless the general laws which we have established repose upon too numerous facts to allow any exceptions which may hereafter be discovered to suffice for their complete overthrow. Although, in the creation of organized beings, nature may have followed the course which we have indicated, we cannot, however, but suppose that some exception, some deviation from the rule may have taken place in consequence of causes unknown to us. The phænomena which occupy us here are by no means of such a nature that we may deduce them from a fundamental law with the same certainty that we can deduce the fall of a body or the orbit of a planet from the law of universal attraction. The causes which preside over these phænomena are too manifold and too dissimilar to allow us to calculate the result with certainty *à priori*. But even if we supposed that a perfectly strict law was at the basis of all these phænomena, our knowledge of the remains enclosed in the strata of the earth's crust can never be otherwise than fragmentary. We can never be sure that certain facts do not escape us, the revelation of which

* See previous note at p. 177.—Ed. *Annals*.

would be of high importance to the development of our knowledge.

However the results at which we have arrived may be received, we have only searched for truth. The laws that we have developed as resulting from a geological theory, had revealed themselves long since to our eyes in nature; for during many years we have ever been guided by one single motive—

"*Naturâ doceri.*"

XIX.—*On the Development of Roots, and the Exfoliation of the Cellular Coats of their Extremities.* By Arthur Henfrey, F.R.S.

In the 'Journal of the Royal Agricultural Society of England,' vol. xix. part 2, published in January last, there is an essay on the Structure of Roots, by myself, in the latter part of which is described the mode in which the extremities of roots elongate, and the special arrangements by means of which they are enabled to penetrate the soil. The same subject has more recently been dealt with by MM. Garreau and Brauwers, who appear to have been ignorant of the existence of my paper above referred to; these authors have made some extensive investigations on a further point connected with these root-ends, viz. the possibility that the exfoliated tissue may constitute an excretion capable of exerting an injurious influence upon the same species, and so account for some of the most puzzling phænomena relating to the rotation of crops. As the subject is one of great physiological interest, it may be worth while to extract from the 'Agricultural Journal' those portions of the above-mentioned essay which relate to the anatomy and development of roots, at the same time that I present a translation of the memoir of MM. Garreau and Brauwers. The statements in my own paper are made in somewhat general terms, as it was prepared for a somewhat "popular" class of readers; but they were based upon an original series of investigations which furnished facts in all respects identical with those related in detail by the French authors, to whom, however, exclusively belongs the merit of that part of the inquiry concerning the nature of the substances cast off by the exfoliating radicles.

"The root, as developed in the great majority of plants, presents a highly organized structure, made up of various kinds of true cellular or parenchymatous tissue, together with those kinds of elementary tissue which, under the names of wood-cells, vessels, and ducts, form the hard parts of plants. As a rule, we may divide the internal structures of a root into two regions—

the cortical, and the woody or central region; the former of these is altogether parenchymatous; the latter consists for the most part of woody tissue in natural roots, but contains abundance of parenchyma in plants where the roots become fleshy.

"The *cortical* region is continuous with the rind-structure of the stem, and in young roots consists of a thin layer of squarish parenchymatous cells, more or less densely filled with mucilaginous contents, but completely covered in on the outer surface by a layer of cells firmly connected side by side, forming a kind of skin, called the *epidermis*. This skin is distinguished from that clothing the leaves and young shoots, in accordance with the difference of function, by the absence of the peculiar breathing pores or *stomata*, by which the internal structures of the leaves, &c., are placed in direct communication with the atmosphere. There are no openings of any kind through the skin covering the surface of roots; and the notion formerly entertained of the existence of sponge-like regions at the extremities of roots was an error arising out of imperfect observation, as will appear presently. The cortical region exhibits some striking differences in its subsequent history in different plants. In most cases, especially in the roots of Dicotyledons, and in the branching roots of Monocotyledons, many of the epidermal cells, at a little distance from the growing point of the root or rootlet, grow out into filaments or hair-like processes, constituting the '*fibrils*' of roots. These are mostly invisible to the naked eye; and their presence is chiefly betrayed by the adhesion of the soil to them. When young roots are carefully washed and placed under a magnifying glass, these fibrils are seen very clearly; and on such roots as those of barley, for instance, they exist in enormous numbers.

"At the growing points of roots, the epidermis passes insensibly into the mass of nascent or *cambial* tissue; but the growing point of a root is not at its absolute extremity, which is covered by a cap-shaped or hood-like portion of epidermis of its own, continuous likewise behind with the cambial structure. This cap-like sheath of the point of the root may be compared with the head of an arrow, forming a firm body, which can be pushed forward by the growing force behind, to penetrate through the resisting soil. This cap is subject to destruction and decomposition by external agencies, and is less distinctly seen in roots growing in earth than in those of aquatic plants. In all cases it is constantly undergoing renewal by cell-development at the back part; and when it remains undissolved, as in many water-plants, it becomes very large; when it undergoes decomposition in proportion as it is renewed behind, it presents an irregular,

ragged appearance, which probably gave rise to the idea of a spongy structure at the end of the rootlets.

"In some roots the epidermis produces no *fibrils*, but remains smooth. This is especially the case in the delicate filamentous roots, annually thrown off, of many Monocotyledons, as of the onion, hyacinth, crocus, &c. In these roots the epidermal cells retain their general delicate character throughout their existence; and probably the roots of this character absorb by their surface throughout their whole length; while in woody roots the absorbent action is confined to the rootlets—to the regions near the growing points,—where the epidermis is still delicate and covered with its hair-like fibrils.

"In woody roots, as the whole organ increases in size and the internal part becomes lignified, the cortical region changes its character. The epidermis dries up, and its place is taken by a corky structure, formed of two or three layers of the cells previously subjacent to the epidermis. When this change has taken place, the direct absorbent power may be regarded as lost. Simultaneously with this change, the inner cortical parenchyma often increases considerably in quantity, and this is particularly the case in fleshy roots, where this region subsequently becomes the reservoir of accumulated nourishment.

"The centre of a very young root is occupied by a cord of cellular tissue of different form from the cortical parenchyma, consisting of elongated cells—the *cambium* of the future wood, which merges, near the growing point, in the focus of cell-development lying just behind the apex of the rootlet, where the nascent cells are all alike. The central cord very soon displays traces of the structures called ducts, and the cells assume the form, and more or less the substance, of the wood-cells of the stem. Some important differences exist as to the arrangement of their constituents in different classes of plants. In Dicotyledons (such plants as turnips, beans, pease, our native timber-trees, &c.), the structure of the central or woody part of the root differs from that of the stem chiefly in the absence of a central pith, together with the circumstance that the so-called vascular structure consists of short-jointed ducts, without the more flexible spiral vessels.

"In ordinary Dicotyledonous roots, when no tuberous development occurs, the central woody structure soon acquires its distinctive character. The wood of the stem consists originally of a number of perpendicularly arranged cords, standing in a circle around the pith, a certain number of which pass out into each leaf to form the skeleton of those organs. The lower portions, inside the stem, extend down for a variable distance in different plants. Those of the lower joints of the stem run down into the

roots to form its wood; so that here also we find the woody axis at first in the form of distinct bundles, separated from each other by cellular tissue (*medullary rays*), but crowded closely together in the centre, so that there is no pith. In the young root we find the bundles belonging to the cotyledons largest, between these the bundles belonging to a number of successive leaves. As the stem has its leaves developed, the number of these bundles is increased, until at length a complete circle is formed. When the stem has its joints elongated, the number of bundles extending down into the root is apparently more restricted than when the root is crowned by a tuft of leaves. The bundles belonging to the leaves, formed at a certain height from the root, have their origin at the points where some of the lower ones run out into the leaves, so that they take the place of the latter in the circle surrounding the pith.

"When the root is not tuberous, the woody bundles grow by the conversion of their cambial tissue into wood and ducts, and soon form a solid mass of wood, the wedge-shaped parts of which are more or less distinguishable in different cases. Sometimes the medullary rays separating them remain tolerably large; in other cases these are lost sight of, and the separate bundles are then often only roughly traceable by the arrangement of their larger ducts.

"The woody axis thus formed exhibits at its outer surface (next the rind) a *cambium*-region, where new development of wood takes place, as in the stem, in perennial plants forming annual rings, and where the buds giving rise to branches originate. But when we proceed outwards from here, we miss the next constituent of the stem, namely the *liber*, or bast fibres, which are absent from the root, ending at the 'collar' or point of junction of the root and stem. On the other hand, the cellular structure of the rind or bark is mostly very much developed, and is renewed on the inside by the cambium-region, in proportion as its outer parts are destroyed. The outer part of the rind of oldish roots exhibits a corky texture; and in the roots of trees this rind acquires great solidity, forming a kind of false corky bark if the roots are exposed.

"Where the roots of Dicotyledons become tuberous, very different departures from the regular structure are met with in different plants,—for example, in the turnip and its allies, the carrot, parsnip, &c., and the beet or mangel-wurzel. In the first group the unnatural production of succulent cellular tissue takes place in the medullary rays which invade and break up the woody bundles, and scatter their elements so that they are found distributed in irregular radiating rows in a great mass of parenchymatous tissue. This tissue is by no means a continuation of

the pith of the stem, although it bears some resemblance to it. There is a distinct boundary of wood where the root joins the stem. This is probably of importance as regards the 'keeping' qualities of the roots. In the carrot there is a similar development in the woody region, but not so marked; while an equal, if not greater, production of parenchyma takes place on the outer side of the cambium, forming a thick fleshy rind. A thickened rind of this kind is found in most of the fleshy fibrous roots of perennial herbaceous Dicotyledons, such as groundsel, primrose, &c.

"In the beet, the structure both of the stem and root is unlike that of ordinary Dicotyledons; and the changes produced by cultivation cannot be discussed here.

"The roots of Monocotyledonous plants, such as those of grasses, onions, ordinary bulbous plants, &c., are temporary structures, thrown off year after year, or dying with the stem in annuals. Their woody structure differs very much from that of the roots of Dicotyledons, so that they are easily known by observing a cross section; but the cortical region and the growing extremities differ little in the roots of the two classes. The principal characteristic of the roots of the Monocotyledons lies in their woody central cord exhibiting no trace of distinct bundles separated by medullary rays, but consisting of a central column of wood, with its 'ducts' or vascular structures lying on the outside, at the region where the wood adjoins the cortical parenchyma. A kind of *cambium* exists here also, although no annual rings are ever formed, since it is at this outer surface of the woody region that the root-buds originate.

"The structure of the ordinary roots of herbaceous Monocotyledonous plants may be well examined in the onion. If we place an onion bulb over water in a long glass, like a hyacinth-glass, it soon sends out a number of slender blunt-ended roots, of white colour, the tips only having a yellowish tinge. By placing longitudinal sections of one of them under the microscope, we can trace the mode of development of their roots. The extreme point is clothed by irregularly formed cells, loosely coherent, and evidently being partly thrown off by expansion of the structure beneath; these cells pass laterally into a stratum of elongated cells, which clothe the whole external surface of the rootlet. In the interior of the conical end of the root we find a mass of nascent cells, with their walls scarcely distinguishable, in a state of rapid multiplication by division: this is the chief focus of development of the root. Continuing the examination upward to the older part of the root, the rudimentary cells are soon found arranged in rows parallel to the direction of the root: at first they are very short, then squarish in the side view;

and by degrees they are elongated, until their length is much greater than their breadth; they also expand laterally to a certain extent after their first formation; but this growth ceases, so that the rootlet has a fixed diameter. The cell-division seems to be repeated in these cells in the direction of their length after they have attained their full diameter. While young, near the tip of the root, they are densely filled with protoplasmic substances; as they expand they appear clearer, and contain only a moderate quantity of protoplasm, with abundant watery cell-sap. The rudimentary cells developed in the very centre of the point of growth become cells of much less diameter and more elongated form, and constitute the rudiment of a fibro-vascular cord running through the centre of the rootlet; at a little distance from the point, traces of spiral markings may be detected on the walls of some of these cells, which are becoming *vessels,*—the distinguishing marks of the fibro-vascular bundles. Higher up in the root, the central fibro-vascular cord is clearly recognizable, surrounded by parenchymatous cells, themselves enclosed by a continuous layer of delicate epidermal cells. In these roots the epidermal cells do not grow out in hairs (radical fibrils).

"Roots of this kind show very clearly that the elongation of roots takes place by increase at the point only. This is seen by noticing the relative dimensions of the cells in the different parts; but it may be proved still more evidently by marking the roots, when of some length, at equal distances, with touches of Indian ink. When we watch the further growth of a root thus marked, we see that the spots on the upper part of the root do not become removed to a greater distance from each other, but new structure is added on below the marked parts. The same important law of growth is illustrated by the natural marks made by branches arising from the roots, which remain permanently at their original distance apart, as may be clearly seen in the transverse streaks on the surface of the root of a carrot."

XX.—*Additional Gleanings in British Conchology.* By J. Gwyn Jeffreys, Esq., F.R.S.

In continuation of my notices on this subject, I have only occasion to make a preliminary remark, that, although I have at present no new species to describe, the communication of any facts which may serve to increase our knowledge of already known species is not less valuable or interesting than the publication of novelties.

Acephala Lamellibranchiata.

Teredo megotara, *Forbes and Hanl. Brit. Moll.* vol. i. p. 77.

Dr. Lukis kindly sent me specimens from Guernsey in which the tube is semiconcamerated at its narrower end or opening, as in *T. Norvagica*. They were found in deal and teak wood.

T. malleolus, i. 84. In cork, Plymouth Sound (*Mr. Webster*); and with the last, in a log of deal balk which was cast up on the shore at Guernsey (*Dr. Lukis*). Some of the valves sent me by Dr. Lukis measure $\frac{3}{8}$ths of an inch in length, and are so similar in every respect to those of *T. bipennata* that I am much inclined to doubt their being distinct species, notwithstanding the difference in their calcareous styles or pallets. So little is known of the œconomy of these appendages, that it is possible that the very aberrant forms which they exhibit in these two so-called species may be only a modification of the same organ, depending on a difference of climate or habitation.

Pholadidea papyracea, i. 123. This local and curious shell has been found by Capt. Bedford in lumps of indurated clay which were brought up on fishermen's lines from clayey ground, at a depth of about 25 fathoms, near Lismore on the west coast of Scotland. One of the specimens has the dried remains of the animal in it. In the same matrix which contained the *Pholadidea* are firmly imbedded fossil specimens of *Nucula decussata*, some of which retain their epidermis. The last-named species is found living in the same locality. This association of species, which, in their recent state, are regarded by some conchologists as being respectively characteristic of northern and southern latitudes, is somewhat remarkable; though I believe the *Pholas Vibonensis* of Philippi (Enum. Moll. Sic. ii. p. 46, t. 13. f. 5) is the young of *Pholadidea papyracea*, while the other species has been described and figured by Bronn as well as Philippi under the names of *Nucula sulcata* and *Polii*—the first species as a pleistocene fossil, and the last both as recent and fossil. The lumps of clay appear to have been consolidated by a calcareous deposit or infiltration, and they are as hard and compact as many kinds of stone. Dr. Capellini informs me that an equally compact kind of stone, which is considered to be pleistocene, and contains fossil shells of that period, occurs at Leghorn, and is extensively used for building. I have now (August 23) found the *P. papyracea*, as well as the dwarf variety mentioned in the 'British Mollusca,' alive, in small lumps of triassic sandstone which were dredged up from a depth of 80 fathoms in the Irish Sea, off the coast of Antrim. I may take this opportunity of observing that all the shells and other animals which I took with the above have their colour quite as vivid as the same species which inhabit a much less depth, or even the sea-shore. Such is the case with *Trochus zizyphinus, Tapes virginea, Natica nitida, Munida Rondeletii, Pandalus annulicornis*, and a small streaked *Actinia*. It appears to be a popular error, that at depths exceeding 50 or 100 fathoms, colour becomes less bright or even evanescent.

Sphænia Binghami, i. 190. Not uncommon in rolled pieces of chalk, as well as among the roots of *Laminaria digitata*, on the north-eastern coast of Ireland. I much doubt its having the power

of "burrowing," or excavating the stones and shells in which it is often found. Sometimes adult specimens have their shells strangulated, and more or less distorted, so as completely to fit the cavities in which they are enclosed; and I believe this mollusk, like *Kellia suborbicularis*, only uses the excavations which had been previously made by Annelids. I suspect the same to be the case with *Cliona perforans*, and that this curious Sponge only occupies deserted galleries.

Mya truncata, i. 163. A young specimen was taken alive in 80 fathoms water, by dredging off the coast of Antrim, at a distance of about ten miles from the shore. This species, as is well known, is usually found between tide-marks.

Poromya granulata, i. 204. A comparison of our shell with a specimen of the *Embla Koreni* of Lovén from Upper Norway induces me to confirm the surmise made by the authors of the 'British Mollusca,' that they are one and the same species. Nyst's specific name, however, has precedence in date.

Thracia convexa, i. 229. A young specimen was taken by Mr. Barlee in Zetland last year.

T. distorta, i. 231. I believe this is only an abnormal form of *T. villosiuscula*, and that they constitute but one species. The former name has, of course, the priority, although it is not so generally appropriate as the other. The first lines of growth are evidently the same in each; and it is only after the habitat is changed that a marked difference appears. The *Anatina truncata* of Turton may be regarded as an intermediate form. An analogous difference, occasioned by the habitat being free or enclosed, occurs in *Tapes pullastra* and its variety *perforans*, which was formerly considered a distinct species.

Lyonsia Norvegica, i. 214. St. Martin's Bay, Guernsey (*J.G.J.*); St. Catherine's Bay, Jersey (*Rev. A. M. Norman*).

Solecurtus candidus, i. 263. In dredged sand from Belfast Bay.

Psammobia costulata, i. 279. With the last.

Syndosmya tenuis, i. 323. Gronville and St. Catherine's Bays, Jersey (*Rev. A. M. Norman*).

Mactra elliptica, i. 356. I am much inclined to doubt this being anything more than a deep-water variety of *M. subtruncata*, having intermediate specimens from Guernsey and Ardrossan, in the last of which the transverse sulci only appear in the later period of growth.

Tapes pullastra, i. 382. A large, but worn, single valve, which belongs to the form named by me *Venus plagia* (described in the 'Annals of Natural History,' ser. 2. vol. xix. p. 313), has been found by Mr. Hyndman at Larne in Belfast Bay, and was obligingly presented by him to me. It measures $2\frac{1}{4}$ inches in length, and $1\frac{2}{3}$ in breadth. The peculiar obliquity of its shape and greater breadth, as well as the acute angle in which the anterior extremity terminates, incline me to retain my former opinion that it is not a variety of *T. pullastra*. In some respects it resembles *T. virginea*.

T. aurea, i. 392. Southend, Essex.

Circe minima, i. 446, var. latior et complanata. Belfast Bay.

Astarte compressa, i. 464. I found single valves of the smooth variety, with *Astyris Holbōllii*, by dredging off Larne on the north-eastern coast of Ireland, in about 25 fathoms. The ribbed and convex form (*A. globosa* of Möller) occurs as a pleistocene fossil in the neighbourhood. See notice (*post*) of *Margarita cinerea*.

A. triangularis, i. 467. The non-crenation of the margin does not depend on age (as supposed by the authors of the 'British Mollusca'), for I possess specimens which are evidently adult and of the same size, some of them having the margin quite plain, while in others it is strongly crenulated.

Cardium edule, ii. 15; var. ovalis, compressa, margine antico subrecto. Herm (*Dr. Lukis*). This variety is as remarkable as the *C. rusticum* of authors.

C. punctatum (*C. nodosum*, ii. 22). Gorey, Jersey; very fine (*Rev. A. M. Norman*).

C. fasciatum, ii. 25. Some specimens from Zetland show decided punctures in the interstices of the ribs, which are apparently caused by the concentric wrinkles being more than usually crowded together in this part.

C. pygmæum, ii. 29. Gorey, Jersey (*Rev. A. M. Norman*).

Lucina borealis, ii. 46. There are two distinct forms or varieties of this species: one is compressed, with few and distant ribs; and the other is gibbous and smaller, with the ribs more numerous and close together. The last variety has been taken by Mr. Norman in Bantry Bay, and by myself in Guernsey.

L. leucoma, ii. 57. Jersey, at low water (*Rev. A. M. Norman*).

Sphærium rivicola (*Cyclas rivicola*, ii. 111). Beeston Brook, near Liverpool; Surrey Canal; Minchinhampton; Devizes (*Mr. Webster*).

S. ovale. M. Bourguignat, in his Monograph on the French species of *Sphærium* (p. 31, pl. 6. f. 6), refers this species, which was founded by Férussac, to the *Cyclas lacustris* of Draparnaud,—the *Tellina lacustris* of Müller being a different species, and identical with the *Cyclas calyculata* of Draparnaud. It is the *Sphærium pallidum* of Gray.

Dreissena polymorpha, ii. 165. Mr. Barlee informs me that it abounds in the river Witham in Lincolnshire, five miles from the sea; and that the river is not navigable by vessels above half a mile from Boston, where there is a sluice and lock to keep out the tide. It is more than probable that this species is indigenous to Great Britain, and was not originally imported from the Continent.

Mytilus edulis, ii. 170. The epidermis in young individuals is clothed with short hairs, which in after-growth appear to fall off. This is another link which unites the genus to *Modiola*.

Modiola radiata (*M. tulipa*, ii. 187). Jersey (*Rev. A. M. Norman*). The large variety from Falmouth has been lately figured by Mr. G. B. Sowerby, in his very useful work entitled 'Illustrated Index of British Shells' (pl. 7. f. 7), as a distinct species, under the provisional name of *Modiola ovalis*. If the normal form be found with it, the distinction may be a good one, as I am not aware that any intermediate variety has been discovered.

M. barbata, ii. 190. Guernsey (*J. G. J.*); Jersey (*Rev. A. M. Norman*).

M. cuprea, *Ann. Nat. Hist.* 3rd ser. vol. iii. No. 13. p. 40; *Sow. Ill. Ind.* pl. 7. f. 11. The indigenousness of this species is somewhat doubtful, as it now turns out that Mr. Bean's specimens were taken by Mr. Alfred Roberts, a bird-stuffer at Scarborough, from the crop of a *Brent-goose* (instead of a Sanderling) which had been shot there during the severe winter of 1855. Roberts appears to have had good cause for remembering the circumstance, from having lost his Sunday dinner. Having heard that the Brent-goose was "an excellent-eating bird," he depended upon this, and bought nothing on the Saturday; and, to his disgust, when his wife attempted to prepare it for the spit, the *ulva* on which it had fed smelt so very "loud," that bread and cheese had to be substituted. The Brent-goose is a northern bird, and an occasional visitant to this country. The shells retain all the original brilliancy of gloss and colour, and they may certainly have been picked up on the British coast.

Crenella rhombea, ii. 208. Gronville Bay, Jersey (*Rev. A. M. Norman*).

Arca lactea, ii. 238. In dredged sand from Belfast Bay.

Pecten furtivus, *Lov.* (*P. striatus*, var., ii. 284). A single valve occurred to me in dredged sand from Belfast Bay; and I have since found it alive, and not unfrequently, in the Irish Sea, off the coast of Antrim.

P. opercularis, ii. 299. The very young have a rhomboidal form, and the lower or flat valve is much smaller than the other (which overlaps it) and is perfectly smooth. The ribs do not at first appear on the larger valve, but are preceded by a shagreen reticulation.

Anomia ephippium, ii. 325. Specimens which I found many years ago in Swansea Bay, on a mussel bed which was uncovered at a very low spring tide, present the anomalous character of having the foramen in the lower or flat valve closed by a series of convex layers of thin shelly matter. They were alive, and attached to the mussels by the byssal threads of the latter mollusks; and it appeared to me that, having been detached from the oysters or stones to which they were originally fixed, and thus deprived of their plugs, they filled up the openings in the above manner for the sake of protection against whelks and other enemies, being securely held by the mussel moorings.

Gasteropoda Prosobranchiata.

Chiton gracilis, *Ann. Nat. Hist.* 3rd ser. vol. iii. No. 14. p. 106. Gronville Bay, Jersey, with *C. discrepans*; rare (*Rev. A. M. Norman*).

C. Hanleyi, ii. 398. In deep water on the north coast of Ireland, with *Pholadidea papyracea* (*J. G. J.*). It is recorded in the 'Journal de Conchyliologie' as having been taken at the Antilles.

C. cancellatus, ii. 410. With the last, at low water (*Rev. A. M. Norman*). Irish coast, off Larne, in about 18 fathoms (*J. G. J.*).

Calyptræa Sinensis, ii. 463. At Helford River, Cornwall; most abundant and fine, both at low-water mark and dredged (*Mr. Webster*).

Puncturella Noachina, ii. 470. Belfast Bay.

Emarginula reticulata, ii. 477. The fry closely resembles a *Scissurella*, and has a regular Trochoidal spire, with the edges of the slit inflected.

E. rosea, ii. 479. Jersey (*Rev. A. M. Norman*).

Haliotis tuberculata, ii. 485. Dr. Lukis informs me that in Mrs. Collings's collection is a specimen, about an inch and a quarter in length, in which the perforations were absent from the very earliest period of growth, being quite a congenital deformity. And he adds that, although the demand for ormer shells, as articles of commerce, is on the decline, one merchant had (in February last) at least fifteen to twenty tons weight in store; that at sorting-time every shell is separately examined, and that the best lots fetch on the spot for exportation about seven shillings and sixpence per hundredweight; and that the quantity brought to this merchant varied, in the season, from four to nine tons. It appears to be found in Alderney, and also (though rarely) in Jersey.

Trochus alabastrum, ii. 497, var. alba. Zetland (*Mr. Barlee*).

T. exiguus, ii. 505. Jersey (*Rev. A. M. Norman*).

T. striatus, ii. 508. In dredged sand from Belfast Bay.

T. Montagui, ii. 511. Jersey (*Rev. A. M. Norman*). An exquisite scalariform variety has been found by Mr. Waller and myself, by dredging off the north-eastern coast of Ireland; but it is very rare. The animal does not differ from that of the usual form.

Margarita exilis (*Skenea? Cutleriana*, iii. 164). Falmouth, rare (*Mr. Webster*); Fowey, abundant in dredged sand (*Mr. Barlee*).

M. cinerea, *Gould, Inv. Mass.* 252. Mr. Waller and myself have each found a specimen in dredged sand from the Turbot Bank in Belfast Bay. They appear to be recent, although not in good condition. Mr. Hyndman has kindly furnished me with some shells (principally *Astarte sulcata*) which were taken from a pleistocene bed near Belfast, lying about 90 feet above the present level of the sea. All of them want the transparence and gloss which distinguish the shells supposed to be of Arctic origin and lately dredged in Belfast Bay. Although the latter are not pleistocene, there may still be a question whether they are not *post*-pleistocene, or the relics of the glacial epoch, like *Leda pygmæa, Arca raridentata*, and other species, which apparently survive only in a few, but widely separated, parts of that extensive region which was once subject to an Arctic temperature. Lovén has recorded *M. cinerea* as occurring in Finmark. I have since found and examined a bed of pleistocene fossils lying by the road-side about half-way between Larne and Glenarm, about 80 yards from high-water mark, and 15 feet above it. It is situate about ten English miles from the Turbot Bank. All the shells contained in this bed appear to be decidedly of an Arctic character, and include *Hypothyris Psittacea*; but few of them, and those having an extensive range of geographical distribution, have as yet

been detected in the adjacent sea. In texture and appearance, all these fossils are very different from the shells taken on the Turbot Bank. Local information has satisfied me that none of the last-mentioned shells could have been brought from any distance by marine currents; and indeed I have found nearly all the species living in the immediate locality.

M.? costulata (*Skenea? costulata*, iii. 167). Mr. Waller found two specimens with the last, and in the same condition, one of which he has obligingly presented to me. Mr. Barlee has also taken a small specimen in dredged sand from the Shetlands.

Adeorbis subcarinatus, ii. 541. The supposed operculum of this unknown mollusk (p. 543) is the *Spirillina perforata* of Williamson (Mon. Brit. Rec. For. in the publications of the Ray Society, p. 92. f. 202), and belongs to the *Foraminifera*.

Bithynia Leachii, iii. 16. Neighbourhood of Boston (*Mr. Barlee*); var. minor, Northamptonshire (*J. G. J.*).

Littorina littorea, iii. 29. On the shore of the Thames, at Southend, nearly all the specimens are more or less eroded, and so much so in some cases as to appear distorted. This cannot, I think, be owing (as supposed by some naturalists) to the admixture of fresh water with the sea, because in the same locality, where a small stream empties itself into the Thames, none of the specimens are similarly affected, while on the sea-shore at Tenby, where there is no flow or infiltration of fresh water, dwarf specimens of *Mytilus edulis* (var. *incurvatus*) are partially eroded, and the limestone rocks are fretting away from apparently the same cause. On the opposite coast of North Devon the *Purpura lapillus* presents a similar case of erosion; and the *Chthamalus punctatus* derives its specific name from such marks. Other instances of the same kind will doubtless occur to many of my readers. I believe this erosion is caused by the action of carbonic acid, which is evolved by sea-water in considerable quantities under certain conditions, aided by the gyratory motion and reflux of the tide.

L. fabalis, iii. 49. This variety of *L. littoralis*, is found with the young and an intermediate form of the typical species on the shores of Larne Lough, in the north-east of Ireland; and it confirms my former impression that these two so-called species ought to be united. A similar intermediate gradation of form occurs in the same place with respect to *L. rudis* and its variety *L. tenebrosus*.

Lacuna labiosa, *Lov.* iii. 66. In dredged sand from Belfast Bay; a single specimen.

L. crassior, iii. 67. Specimens from Guernsey and Belfast Bay have a distinct canal or groove in the columella, evidently showing its generic position. I am now enabled to add a note of the animal, which settles the question. It is of a yellowish-white colour, having two subulate and slender tentacles, with the eyes placed on short peduncles at their external base; proboscis long and narrow; two rather long caudal filaments, one on each side of the operculigerous lobe. The creature is active in its habits, and seems fond of crawling out of water.

Assiminea Grayana, iii. 70. I have traced this peculiarly local species along the banks of the Thames from Greenwich (its original locality) to about two miles below Gravesend, being a distance of more than twenty miles.

A. littorea (*Rissoa? littorea*, iii. 132 and iv. 265), var. pallida. Weymouth.

Rissoa calathus, iii. 82. In dredged sand from Belfast Bay.

R. cimicoides (*R. sculpta*, iii. 88). Cork Harbour (*Mr. Wright*).

R.? fulgida, iii. 128, var. efasciata. South Devon (*Mr. Webster*).

R. subumbilicata, *Ann. Nat. Hist.* 3rd ser. vol. iii. No. 14. p. 108. Southend (*J. G. J.*); Clevedon (*Rev. A. M. Norman*); Birkenhead (*Mr. Webster*). The last whorl of the shell is never keeled, as in *R. ulvæ*.

R. Barleei, *Jeffr.* *Ann. Nat. Hist.* vol. xix. p. 310 (*R. ulvæ*, var., iii. 143). In deep water, Plymouth (*Mr. Webster*). A dwarf and thin variety occurs in Arnold's Pond, Guernsey, associated with *R. ventrosa*, to which latter species (instead of *R. ulvæ*) I would refer the shells mentioned in the 'British Mollusca,' vol. iii. p. 143. I much doubt if *R. ulvæ* is found in Guernsey, as that island is destitute of any estuary into which a river flows, which is, I believe, the invariable habitat of that species.

R. castanea (*R. ventrosa*, var., iv. 266), *Sow. Ill. Ind.* pl. 14. f. 11. Mr. Pickering found this species about two miles below Gravesend, and not at Grays, as stated in the 'British Mollusca.' It is singular that he has not been, any more than myself, successful in rediscovering the species, although we have both at different times searched the exact spot for it. It can scarcely be questioned that it is specifically distinct from *R. ventrosa*, which is abundant in the same locality.

R. ventrosa, iii. 138, var. minor. Loughor Marsh, Glamorganshire, with *R. ulvæ*. I am not aware of any other instance in which these species have been found associated together. *R. ventrosa* usually inhabits brackish water, in ditches and ponds which communicate with the sea, but receive an accession of salt water only when the tide is at its full, while *R. ulvæ* affects the mud flats of estuaries which are quite covered by the sea at the same period. The habit of the above variety appeared to be different from that of *R. ulvæ*, inasmuch as all the specimens which I noticed of the former were swimming (or rather creeping) underneath the surface of the water, with their shells in an inverted position, while those of *R. ulvæ* were crawling at the bottom, or attached to sea-weeds. Mr. Alder says, with respect to the linguædental apparatus of these species, "I have examined the tongues of *R. ulvæ* and *R. ventrosa*, and I find the difference between them so slight as to be scarcely appreciable. The principal one is the greater length of the central denticle of the central tooth in *R. ulvæ*. There are also some slight differences in the form of the other teeth; but the general character is the same."

Skenea planorbis, iii. 156. A small variety occurs on the shores of Larne Lough, in Ireland, which has a more convex spire; and it

appears to bear the same relation to the typical form that the *Helix rupestris* of Continental authors does to our *H. umbilicata*.

S. striata (*Valvata? striata*, Phil. i. 147, t. 9. f. 3, and ii. 122). Two specimens have been found by Mr. Waller at Bundoran, in the North of Ireland, one of which he obligingly presented to me. It cannot be mistaken for the young of any British species of *Trochus*. My specimen is nearly one-tenth of an inch in diameter. Although Philippi provisionally assigned it to the genus *Valvata* because he found it in a fossil state, associated with *Cyrena gemellaris* as well as with marine shells, he subsequently thought it might with equal propriety be referred to his genus *Delphinula*. Mr. Searles Wood has, in his 'Crag Mollusca' (Univ. p. 137, tab. 15. f. 7), referred to Philippi's species some fossil shells under the name of *Adeorbis striatus*; but I am not satisfied that there are sufficient generic characters for distinguishing *Adeorbis* from *Trochus*, taking *Adeorbis subcarinatus* as the type.

Skenea? lævis, iii. 165. Mr. Barlee has found another specimen in dredged sand from the Shetlands. I do not believe it is the *Delphinula lævis* of Philippi; and if it proves to be distinct, I would suggest that the specific name of *nitida* be given to our species.

Euomphalus? (Omalogyra) nitidissimus (*Skenea? nitidissima*, iii. 158). On *Zostera marina*, between tide-marks on the shores of Larne Lough, Ireland.

E.? (Omalogyra) rota (*Skenea? rota*, iii. 160). Serk (*Mrs. Collings*).

Cæcum glabrum, iii. 181. It is possible that the *Serpula incurvata* of Adams, instead of being the fry of this species (according to Mr. Clark), may be a species of *Bifrontia*. I possess apparently very young specimens of *C. glabrum*, which merely show a greater curvature of form with a less diameter than the adult, and present the same relative differences that exist between the *Dentalium imperforatum* and *trachea* of Montagu.

Cerithium niveum, *Jeffr. in Ann. Nat. Hist.* Mr. Waller has found specimens of different ages (but more or less imperfect) by dredging on the north-eastern coast of Ireland. It is a true *Cerithium*.

Stylifer Turtoni, iii. 226. Mr. Leckenby informs me that a fine specimen (three-eighths of an inch in length!) was found a year or two ago at Filey by Miss Backhouse. In a note which I have received from Mr. Howard Stewart, as to this rare and interesting species, he says, "Amongst my numerous dredgings for the British *Echinoderms* on the Plymouth coast, I have carefully looked over vast numbers of sea-eggs, &c., for the *Stylifer Turtoni*, but have never found it except on *Echinus miliaris*. In October or November 1855, I found six *Stylifers* on one *Echinus miliaris*, but only one of these was adult; and on another specimen of *E. miliaris* I obtained an adult specimen of the mollusk, and the ova of the same. The ova were so far advanced as to be seen swimming about by means of coarse cilia under the microscope with a low power, and the shells were perfectly formed." Mr. Stewart has since obligingly presented me with these ova, which are disposed in two clusters (probably

separated in their removal from the *Echinus*), and altogether contain 200 or 300 fry. The shells appear to correspond with the first whorl of the style.

Chemnitzia simillima, *Ann. Nat. Hist.* 3rd series, vol. ii. p. 128; *Sow. Ill. Ind.* pl. 16. f. 3 (nom. *C. pusilla*). St. Catherine's Bay, Jersey (*Rev. A. M. Norman*). The *C. gracilis* of Philippi does not appear to have been hitherto found in Great Britain, although a small and slender variety of *C. elegantissima* may have been mistaken for it. This variety has been figured by Sowerby (pl. 16. f. 2) under the erroneous name of *C. simillimus*, referring to Montagu and the *C. gracilis* of Philippi. The true *C. gracilis* is an exquisite shell, and when taken alive it glitters in the sun like a bright needle. In size and diameter it is less than *Eulimella acicula*.

C. rufa, iii. 245. In dredged sand from Belfast Bay.

C. fenestrata, iii. 249. St. Catherine's Bay, Jersey (*Rev. A. M. Norman*).

Odostomia turrita, *Jeffr. in Ann. Nat. Hist.* 2nd ser. vol. ii. p. 339 (*O. striolata*, iii. 267). Bantry Bay (*Rev. A. M. Norman*).

O. acuta, iii. 269. St. Catherine's Bay, Jersey; very large (*Rev. A. M. Norman*).

O. alba, iii. 278, var. gracilior et carinata. Belfast Bay (*Mr. Waller*).

O. Lukisii, *Jeffr. in Ann. Nat. Hist.* 3rd ser. vol. iii. p. 112. South of Devon (*Mr. Webster*).

O. glabrata, iii. 283. With the last; but very rare. It has somewhat the aspect of a young *Rissoa vitrea*.

O. diaphana, *Jeffr. in Ann. Nat. Hist.* 2nd ser. vol. ii. p. 341; *Sow. Ill. Ind.* pl. 17. f. 23. In dredged sand from Zetland; rare. Mr. Sowerby justly remarks that this species is "manifestly distinct" from *O. obliqua*.

Eulimella clavula, iii. 314. Guernsey; very rare.

Natica Helicoides, iii. 339. I found a young specimen in dredged sand from Belfast Bay.

N. pusilla, iii. 341. Mr. Barlee has taken this species alive in the Shetlands.

Trichotropis borealis, iii. 361. In dredged sand from the Turbot Bank, Belfast Bay; and I have lately found it alive in the same part of the Irish Sea.

Cerithiopsis pulchella, *Jeffr. in Ann. Nat. Hist.* Mr. Waller has taken this unmistakeably distinct species on the north-eastern coast of Ireland. It has been recorded in the Report of the Belfast Dredging Committee (furnished to the British Association in 1857) under the name of *Cerithium metula*.

Nassa pygmæa, iii. 394. Belfast Bay (*Mr. Waller*).

Buccinum Dalei, iii. 408. The operculum proves that this species is a true *Fusus*; and the shell wants the columellar fold of *Buccinum*.

B. fusiforme, iii. 412. Mr. M'Andrew procured two specimens (one of them being nearly adult, and the other younger) by dredging off the coast of Finmark; and the operculum, as well as the absence of a columellar fold, clearly show that this species must also be re-

moved from *Buccinum* to *Fusus*. The operculum in this and the last species is unguicular, and has a terminal nucleus. The apical whorls of this shell closely resemble those of *Fusus Berniciensis*. As the present specific name is manifestly inappropriate, I would venture to suggest that it should be changed to *Broderipi*, as a slight testimony to the memory of its late lamented discoverer.

Fusus Berniciensis, iii. 421. Among the results of Mr. Barlee's last dredgings in Zetland is a remarkably solid and evidently very old, though recent shell, which I must provisionally assign to this species. It is nearly four inches in length, and not quite an inch and a half in breadth, being therefore of a more slender form than *F. Berniciensis*. But the peculiarity of this specimen consists in the apical whorls not being blunt and symmetrical, as in *F. Berniciensis*, but pointed and mammillary, as in *F. Islandicus*. The outer lip is of equal thickness with the rest of the shell, and is strongly ribbed on the inside near the mouth. I at first suspected that the difference in the form of the apical whorls might be sexual, and that the same relation might subsist between this variety and *F. Berniciensis* as between *F. Islandicus* and *F. propinquus*; but I have since ascertained that male and female individuals of *F. antiquus* do not exhibit any variation in this respect.

F. Norvegicus, iii. 428. Mr. Barlee procured a very young specimen of this shell in his last Shetland dredgings.

Trophon clathratus, iii. 436, var. alba. With the last (*Mr. Barlee*).

T. Barvicensis, iii. 442. Not uncommon on the north-eastern coast of Ireland.

Triton cutaceus, iii. 446; *Sow. Ill. Ind.* pl. 18. f. 1. Dr. Lukis informs me that a full-grown and perfect specimen was taken alive in February last (1859) by Mr. John Rougier from a large flat stone in the south-west of the island of Lihou, while he was engaged in gathering ormers (*Haliotis tuberculata*) at the extreme verge of the lowest spring tide. It is now in the public museum at Guernsey.

Mangelia Trevelliana, iii. 452. In dredged sand from Belfast Bay; very rare.

M. rufa, var. Ulideana, iii. 457. Mr. Norman says he has lately taken, in St. Catherine's Bay, Jersey, a magnificent and living specimen of this pretty variety with the typical form. I have also found it at Tenby. It may be a distinct species.

M. teres, iii. 462, var. alba. West of Ireland and Scotland (*Mr. Barlee*).

M. Leufroyi, iii. 468. In dredged sand from Belfast Bay (*J. G. J.*); var. pallida. Zetland (*Mr. Barlee*).

M. lævigata, Phil. (*M. nebula*, var. iii. 480). St. Catherine's Bay, Jersey (*Rev. A. M. Norman*).

Gasteropoda Opisthobranchiata.

Cylichna mammillata, iii. 514. Falmouth (*Mr. Webster*).

Scaphander lignarius, iii. 536, var. alba. West of Ireland and Zetland (*Mr. Barlee*).

Philine quadrata, iii. 541. A small specimen has occurred in our dredgings off the north-eastern coast of Ireland, in 80-fathom water.

P. pruinosa, iii. 549. Plymouth Sound (*Mr. Webster*).

Gasteropoda Pulmonifera.

Arion flavus, iv. 9. On horse-chestnut leaves near Norwich (*Mr. Bridgman*).

Helix nemoralis, iv. 54, var. nana. Zetland (*Mr. Barlee*).

Pupa Anglica, iv. 99. Brombro' Wood, between Birkenhead and Chester; first found there by D. Cameron, Esq. (*Mr. Webster*).

P. minutissima, iv. 104. Mr. Leckenby informs me that this species has been found rather plentifully upon the magnesian limestone near Pontefract. Mr. Howse had also taken it on the same soil near Sunderland.

Achatina acicula, iv. 130. From the circumstance that the tentacula are destitute of eyes, M. Bourguignat has, in his "Aménités Malacologiques" (published in the 'Revue et Magasin de Zoologie'), proposed for this and a few other allied species the generic name of *Cæcianella*. It may be observed that *Testacella* and some of the *Helicidæ* have the same subterranean habit.

Limneus glaber, iv. 178. Near Bowness (*Mr. Webster*).

Acme lineata, iv. 204. In tufts of *Hypnum triquetrum*, Headington-wick Copse, near Oxford (*Mr. Whiteaves*).

Sepia biserialis, iv. 241. Mr. Norman informs me that he has lately taken a bone of this rare and peculiar cuttle-fish at Jersey. I found an imperfect specimen many years ago at Rochelle.

London, August 1859.

P.S. *Pholadidea papyracea.*—I have just received the following note from my friend Dr. Capellini, with reference to the claystone which Captain Bedford found perforated by these mollusks, and in which the *Nucula decussata* had been previously imbedded. It will, I think, be found interesting in a palæontological point of view.

"Amico carissimo,—Ho veduto con molto interesse gli esemplari di roccia con fossili identici a quelli trovati da Philippi nel pleistocene di Sicilia; e riguardo all' origine della roccia stessa non dubito punto che essa sia argilla resa più o meno compatta dalla presenza del carbonato calcare.

"In uno degli esemplari che ha avuto la bontà di mostrarmi, si vedeva chiaramente il passaggio dall' argilla al calcare argilloso, e quel frammento mi ricorda che ho avuto occasione di osservare un fatto analogo nelle argille mioceniche della Val di Magra, a poche miglia dalla Spezia.

"Non conosco per mie proprie osservazioni la Sicilia ed Ischia, ove probabilmente sono roccie pleistoceniche simili ai suoi esemplari, ma, a Livorno, una delle più interessanti località per lo studio del pleistocene in Italia, le roccie spettanti a quel periodo e che si distinguono nel paese coi nomi di tufo e panchina, hanno tutt' altro aspetto delle sopra citate; poichè l'una è un calcare grossolano molto spugnoso,

con abbondanti resti di conchiglie littorali, l'altra è una specie di conglomerato.

"Da tutto cio ella vede non esser possibile basarsi sui caratteri litologici per segnare l'età di una formazione, perchè roccie di aspetto e di composizione identica si trovano spesso in terreni che spettano ad epoche svariatissime; dippiù potrei citarle roccie che sono attualmente in via di formazione e che pure presentano compattezza ed aspetto da confondersi con roccie di terreni molto antichi.

"La litologia non può servire che a sincronizzare terreni i quali geograficamente sono a non troppa distanza gli uni dagli altri; in caso contrario, il geologo si trova subito nell' impossibilità di fare a meno della paleontologia.

"Senza conoscere gli altri fossili che si troveranno nelle roccie da Lei presentatemi, e senza aver notizia delle loro condizioni stratigrafiche non oso pronunziare sull' età loro il mio giudizio, come ho fatto per il loro modo di formazione; *benchè per conto mio sia persuaso, come Ella, trattarsi di un terreno pleistocenico analogo a quello studiato da Lyell ad Ischia*: ivi pure sono argille turchine con conchiglie che vivono anche attualmente nel vicino mare.

"Mi creda, &c.

Londra, 10 Agosto, 1859. "Dr. G. Capellini."

XXI.—*Researches on the Cellular Formations, the Growth, and the Exfoliation of the Radical and Fibrillar Extremities of Plants.* By MM. Garreau and Brauwers*.

In a series of researches undertaken by one of us, with the view of acquiring a knowledge of the causes which preside over the distribution of mineral matters in the different organs of plants, we had occasion to remark that when seeds germinated at a temperature of 68° to 78° Fahr., the points of the radicles, and subsequently the fibrillar extremities of the roots, frequently bore, very soon after their emergence from the axis, more or less marked traces of a cellular exfoliation, or a tear-shaped enlargement of a viscous consistence, although both were placed in media suited for the regular accomplishment of their physiological functions.

As these facts seemed therefore to depend on their normal development, it became interesting to examine them with care. Prof. Link, in an essay only too concise, distinguished by the accuracy of the optical observations it contained†, directed the

* Ann. Sc. Nat. 4 sér. x. p. 181; translated by A. Henfrey, F.R.S.

† Ann. des Sc. nat. 3 sér. xiv. 5. Besides this work of Link, readers interested in this subject should refer to a memoir by M. Gasparrini (Ricerche sulla Natura dei Succiatori e la Excrezione delle Radice, &c.), published at Naples in 1856, and referring to the question which has been the object of the investigations of MM. Garreau and Brauwers.—*Note of* Ed. *of* Ann. des Sc. nat.

attention of botanists, in 1850, to the excoriation and the mode of increase of the radical fibres of the hyacinth, and the viscous thickening which is observed at the extremity of young adventitious roots of willows; but while the figures he gives of the objects represent faithfully what occurs at the seat of the elongation of the tissue, this is not the case with that part of his essay which refers to the elementary formations of these organs, since he states them to arise from an extra-cellular cambium. Moreover, the objects to which this botanist directed his investigations were too limited in number, and the conditions of the experiments were not sufficiently varied, for anything like a profound study of the subject. It may be added that in science, whatever the object attempted, it often happens that interesting facts escape even the most patient observers; and it may be imagined that, notwithstanding the merit of the author just cited, our researches are justified by the hope of adding some new facts to this important question.

For the greatest facility and success of observations of the facts relating to the cellular formation and growth of the radicle, it is of great importance to trace its development in the absence of contact of any foreign body capable of adhering to or affecting its surface. With this view, selected seeds of very diverse species were placed, moistened with rain-water, upon hair-sieves, and covered with a moist woollen cloth. These seed-beds, placed in pots which contained water at the bottom, kept the seeds in a constantly moist atmosphere; thus the radicles, whose development proceeded more or less rapidly according to the temperature (which could be adjusted at will), formed tufts, beneath the meshes of the sieve and above the surface of the water, in which the subjects of observation, equal in age and dimensions, afforded means both for multiplied examinations and control of the observed facts.

Seeds placed in these conditions germinated much more quickly, at equal temperature, than in the best-prepared earth, —a result which appears attributable to the free access of air. Thus, at a temperature of 78° F., the radicle of cress was protruded from the seed-coats in eight hours, those of *Camelina* in fifteen, and from the caryopsis of little millet in two days.

When the radicle begins to sprout, it is usually smooth all over its surface, and presents no mark of exfoliation when the germination takes place in the ordinary thermometrical conditions of the atmosphere in the climate of Lille; but at a temperature of 68° to 78° F., the exfoliation begins very early in plants with feculent perisperm or cotyledons; and this more precocious tendency to exfoliate coincides, as we shall soon see, with a peculiar mode of dislocation of their elementary organs.

The radicle of wheat (*Triticum sativum*) when it originates in the ordinary conditions of the atmosphere, presents itself in the form of a cylinder conical at its apex, and in the centre of this latter region exhibits a portion of a sphere formed of quadrilateral cells, which, coloured of an amber tint, taken as a whole, differ distinctly from the more elongated and colourless cells which cover them. The former constitute what, for the better comprehension of the facts, we will call the summit of the radical axis, and and the latter that of the cortical layer.

Taken in these conditions, and at the outset of the germination, all the cells of the cortical layer, including those of its apex, are smooth and coherent, and the most external are longer than those which they immediately cover.

In proportion as the organ grows, it is observed that the epidermal cells, which are of larger size according as they are placed nearer to the base of the radicle, contain an animal matter which is coloured pale rose by deutonitrate of mercury, and dark brown by iodized iodide of potassium. This substance, which contains extremely fine granules, accumulates in the middle region of the cells into a little heap, above which the wall of the cells becomes rounded externally in the form of a slight hernia, into the cavity of which the same matter passes; and in proportion as it accumulates there, this appendix becomes developed, until it acquires a length equal to twice or three times the diameter of the radicle; so that each epidermal cell with its absorbing appendix (radical hair, A. H.) presents the form of a cross with an excessively long shaft.

It is not possible to trace the mechanism by which this substance determines the elongation of a portion of the wall of the cell into this appendix; but we may conjecture that, as the essential agent of all cellular formations, it is this which secretes and coordinates the materials.

In proportion as the radicle is developed, and usually when it has attained a length of 1 to 3 centimetres, it may be observed that its apex is swollen, and has assumed the form of a tear. This region, which is viscid to the touch, readily becomes softened when immersed in water, communicating to it a consistence like that of white of egg, and a very marked sweet taste.

The radical extremities of 500 grammes of wheat, immersed in distilled water, gave a solution which, when heated to 140° F., presented flocculent coagula of azotized matter (caseine, albumen); and when this matter was separated, and an excess of alcohol of 0·815 spec. grav. added to the liquid, there was produced a pulverulent deposit in a grumous mass of pasty consistence and sweet taste, formed of a mixture of dextrine and sugar. The substance precipitated in a state of powder, saccharified starch in the same

manner as diastase; but, however great the number of successive dilutions and precipitations which it was made to undergo, it always retained a notable quantity of dextrine, which could be estimated, by Fehling's solution, at a third of its weight. A portion of the viscid matter in solution in water, filtered, gave by evaporation a transparent residue, scarcely coloured, very prone to decomposition, turning brown at 194° F., and which, when calcined to whiteness, left a small quantity of ashes, in which analysis proved the presence of phosphates of potash and lime. According to this, the substance possesses exactly the composition of a farina saccharified by diastase. This substance, which is also found diffused throughout the proper tissue of the radicle, may serve for the development of this organ; and this supposition gains a certain degree of probability from the fact that it is accumulated in largest proportion in the extremity of the radicle, the seat of the formation and enlargement of the cells.

It is true that, being soluble in water, it may, in case of heavy rains, escape in part from this destination, in which case it would have to be supposed that the excess of this aliment is lost to the plant, and diffused through the soil, to form, as we shall endeavour to show hereafter, what have been called the excretions of roots; but, though there seems to be some foundation for this last conjecture, there is no doubt that this material serves for the development of the central cells which are to exfoliate, since the latter are suspended and grow for some time in the viscid medium, which alone retains them united to the rest of the tissue.

When the radicle of wheat, in the condition just indicated, is examined with a sufficient magnifying power, the moment it is moistened, and under the slight pressure of the covering glass, the outermost coat is seen to fall away; the disjointed cells of which it is composed separate from one another, and float completely isolated in the viscid matter. The cells, as we have seen, are clearly distinguished, by their forms and larger dimensions, from those which constitute the apex of the axis, appearing more elongated the further they are placed from the curved line which bounds this region,—a fact which indicates that they must necessarily originate at the confines of that line.

The cells, transparent and full of granules which are coloured yellow by iodized iodide of potassium, are pushed forward and to the sides by the new formations. In proportion as they are removed from the point where they are formed, they grow in all dimensions, the nitrogenous granules they contain becoming more rare; then they increase in length, and remain applied upon the persistent portion of the epidermis, or more or less

speedily exfoliate. These elongated cells, taken in the adult condition, are devoid of large granules; but their living substance presents itself then in the form of a nucleus connected with the internal membrane by filaments in which exist rapid currents conveying granules of extreme tenuity. Subsequently, when the cell has acquired its full size, the substance of the currents and the nucleus becomes divided, in each cell, into two or three masses, of oval form, which soon constitute two or three cells placed end to end, but which ultimately separate from one another.

The radicles of millet, barley, buckwheat, beans, clover, lentils, vetch, wild chicory, *Crepis virens*, and hollyhock, taken in the same conditions, present exactly the same mode of growth and exfoliation of their cortical layer, with this exception only—that the exfoliable layer of the radicle of the hollyhock is comparatively very abundant, rich in viscid matter, and the cells of which it is composed more closely packed than those of wheat, although loosely connected, in the manner of an epidermis, by the interposed viscid substance.

The radical extremities of wild chicory, of cultivated lettuce, of *Crepis virens*, of *Papaver somniferum*, black mustard, and cultivated *Camelina*, allowed to exfoliate in distilled water, gave solutions which, on evaporation *in vacuo*, left residues scarcely coloured, of a gummy aspect. Those obtained from the radicles of chicory and *Crepis virens* exhaled a poisonous odour, and had a bitter taste analogous to that of lactucarium. That furnished by the radicles of poppy has the odour and taste of opium, and those derived from black mustard and *Camelina* have a saline sulphurous taste, and emit an unbearable alliaceous odour.

These matters, which, in the ordinary course of vegetation, are abandoned to the soil, seem to afford an explanation of the antipathies of certain plants towards others, since direct experiment has proved that they are always hurtful when they are absorbed by the plants in sufficient quantity.

That portion which, for the better comprehension of the facts, we have called the axis of the radicle, presents greater difficulties in its study, depending in part on the fact that its summit is masked by the adhering cortical zone not yet exfoliated, and in part that some of the cells of this latter region are loaded with very fine feculent granules, which interrupt the passage of light. But by removing the point of the radicle to the extent of about a quarter of a millimetre, and moistening its apex with a drop of phosphoric acid diluted with twice its weight of water, the still adherent cortical cells may be made to exfoliate, and the extremity of the axis of the root is set free, while the feculent granules of its cells are dissolved, and leave the tissue conveniently transparent.

These cells, which are united so as to form an axis or cylinder, whose free extremity ends in a hemisphere, have the form of quadrangular prisms enlarged about the middle; they decrease from the base of the organ towards its apex, so as to become cubical or tubular in that region, where, by the aid of a sufficient number of preparations, it may be ascertained that those cells which bound the hemispherical portion of the axis, devoid of feculent granules, are furnished with proteinous substances collected in each cell into two or four distinct masses, such as are observed in the later phases of the development of pollen-cells.

Very soon each of these masses, which continues the symmetry of a row of cells, becomes a new cell, so that the multiplication takes place by a binary or quaternary formation in the interior of mother cells, and not, as Link supposed, at the expense of an extra-cellular cambium. We have not been able to determine whether these new cells result from the formation of simple septa in the mother cell, or by double septa produced by the application together of the lateral walls of two young cells formed around the masses of proteinous substance; however, we incline to believe that they originate in this latter manner, because the most superficial layers of these cells are those which, when pushed forwards, constitute the cortical zone, and, as we have said, they exfoliate as complete isolated cells, which could not be the case if there were only a simple septum formed in the middle.

The cells observed immediately above those which are in course of multiplication, at first square and full of feculent granules of extreme minuteness, become a little elongated in the direction of the axis; and while this elongation takes place, the feculent granules disappear, and the living proteinous matter, then visible, becomes condensed in each cell into two or three irregular heaps, between which septa soon appear. These new cells, whose smaller diameter is then parallel with the axis, in part enlarge without undergoing change, and in part multiply by binary divisions parallel to the axis, becoming wider and larger like the former, forming with them linear series resembling those which are formed by the grains of maize on the axis of the spike. One fact worthy of note is, that in proportion as the cells of the radical axis multiply, we perceive, between the parallel rows they form, dark lines (intercellular passages) produced by the presence of air or some other gas which penetrates to within a short distance of the apex of the axis. This mode of multiplication may be observed in the extremity of the axis of millet, where it is even more easily traced than in that of wheat. It is found also in the radicles of buckwheat, barley, hollyhock, and the *Leguminosæ*: everything leads to the

supposition that this kind of development occurs in the generality of plants. Very frequently, when the medium in which they vegetate stands at a rather low temperature, the extremities of the radicles on the fibrils are tardy in exfoliating; and then their elementary cells, instead of becoming detached singly, exfoliate in sheets like an epidermis, strips of which they in fact are.

The seed of black mustard, germinating at 54° F., produces radicles in which the cells of the apex of the axis, and those of the exfoliable layer which clothe it, are filled with granules whose opacity renders the most persevering investigation fruitless. But if we wait until adventitious roots are formed, we may find among these some not more than a fifth of a millimetre in diameter, and perfectly transparent. A fibre of this kind placed on a slide shows, without the necessity of injuring it, its axis with its spiral vessels and its cortical layer, which, instead of exfoliating like that of wheat, becomes detached in the form of a cap, formed by the union of several superimposed layers. A remarkable point is, that these caducous layers cease to be so when the radicle and cotyledon are kept in a sufficiently moist atmosphere, if the saturated atmosphere is only allowed access to the apex of the root. In that case, we see the most external cells of the cortical layer emit absorbent appendices, like those on the epidermis of the base and middle portion of the root, and the spiral vessels, which in ordinary cases terminate at a certain distance from the apex of the radical axis, present themselves quite close to the extreme limit of this region, which shows that there exists an intimate correlation between the functions of the absorbing appendices and those of these vessels, as was supposed by Link. This faculty possessed by the epidermal cells, of emitting absorbent appendices to counteract the deficient supply of water or humidity, has a no less remarkable influence upon the direction of the radicle.

If we moisten the meshes of a sieve with distilled water containing a trace of chloride of calcium, so that the cloth may not become completely dry in the open air, and then scatter over the outside of the cloth seeds of *Camelina*, the latter will adhere readily on account of the mucilaginous film they form when brought in contact with water. If the inside of the cloth of the sieve is then covered with a thick layer of Swedish filtering-paper saturated with water, the seeds germinate, and their radicles, instead of taking a direction perpendicular to the horizon, creep along the outside surface of the cloth, and remain attached to it by the aid of their absorbent appendages*.

* In like manner we often find an extensive felted mass of fine radical fibres adhering firmly to pieces of bone, shell, or porous stone buried in

From this description it is seen that the exfoliation of the cortical zone varies according to the conditions of humidity and temperature under which the radicles are placed; but we must recognize, side by side with these causes, that it is also subordinate to an individual predisposition, since it does not take place always in the same manner when the subjects are placed in identical conditions.

In the radicles of wheat, barley, millet, vetches, clover, pease, lentils, hollyhock, buckwheat, &c., it takes place by complete disunion of the cells in the midst of a viscid layer.

In the poppy, *Camelina*, black mustard, colza, purslane, chervil, corn-salad, &c., it takes place in the form of a hood, composed of cells but slightly adherent, and impregnated with the viscid substance.

In *Œnanthe Phellandrium* the exfoliation takes place in strips composed of epidermal cells, which adhere strongly to the subjacent tissue.

In *Glyceria* it takes place in the form of a hood composed of very firmly coherent cells; in *Lemna* the exfoliable cortical layer forms a sheath, which adheres by its base to the hemispherical portion of the axis of the radicle; and it is remarkable that this hood already exists while the radicle is still enclosed in the coleorhiza. If *Lemna* is examined at the epoch when its radicle is beginning to sprout, this organ will be found in the form of a little cylinder, of a darker colour than the surrounding tissue, and it is contained in a groove existing in the inferior surface of the leaf. This cylinder, now measuring about the fourth of a millimetre, is covered by a membrane in the shape of a sheath, composed of cells contiguous to those which bound the inferior surface of the leaf (coleorhiza).

When the whole is compressed gradually between glass, the sheath is seen to burst at its apex, and allow the exit of the radicle already enveloped in that persistent hood which is observed at the extremity of the root when this is examined in the adult condition*. This layer or hood, which, as we have said, adheres to the apex of the radical axis, grows for a long time after the radicle has ruptured the summit of the coleorhiza; for

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the soil, or to the sides of earthen pots where these are kept moist.—A. H.

* This firm hood-like body, the *pileorhiza*, placed on the point of the root like the head upon an arrow, seems to occur on all nascent adventitious roots, before they have broken out from the cortical layer of the stem. Originating in the cambium-region, they push the cortical or epidermal tissue before them, and absolutely rupture the latter, the ragged edges of which stand up round the base like a collar, forming the so-called *coleorhiza*.—A. H.

when it emerges from this organ it does not measure more than one-third of its ultimate length, although the cells composing it have at this epoch already attained almost the term of their development.

From these researches it may be inferred that—

1. From its very origin the radicle is formed of two distinct tissues, both cellular.

2. That which constitutes the external layer of this organ, and which must be regarded as the first rudiment of a cortical stratum, is susceptible of exfoliation, more or less prompt, according to the plants, and the temperature and humidity of the medium in which they vegetate.

3. This exfoliation, which takes place at the apex of the organ, results sometimes in the complete dislocation of the cells, which in this state continue to grow for a certain time in the midst of a viscid matter before being finally thrown off,—sometimes in the solution of these cells, in the form of epidermoid strips or cups, often confounded with the coleorhiza.

4. The exfoliated cells and the substances accompanying them contain, according to the species from which they are derived, substances which appear, when abandoned to the soil, to constitute what have been called the excretions of roots.

5. The tissue which constitutes the hemispherical extremity of the central portion of the radicle is the seat of the formation and growth of the cells; these formations take place at first by the binary and quaternary multiplication of cells, which terminate the apex of the axis; and of the cells newly formed, the most external are pushed forward to constitute the exfoliable cortical layer, while the more internal become filled with feculent granules, and subdivide again a little below the apex of the axis of the radicle, attaining there, without any other apparent change, the term of their increase.

6. The formation of absorbing appendices (hairs) at the apex of the radicle, when it alone is exposed to the contact of moist air, while confirming the existence of a rudimentary cortical layer in that region, bears fresh witness to the tendency of the organism to seek the medium suited to its nutrition.

XXII.—*On the Reptiles from St. Croix, West Indies, collected by* Messrs. A. and E. Newton. By Dr. A. Günther.

[With a Plate.]

A small collection of reptiles made by Messrs. Alfred and Edward Newton in St. Croix (S[ta] Cruz), and presented by them to the Collection of the British Museum, offers a contribution

to our knowledge of the geographical distribution of reptiles throughout the West India Islands, and contains two new species.

Messrs. Newton have kindly communicated to me their valuable notes, which constitute the portions included within inverted commas (" ").

We find a list of animals from St. Croix in Hans West's "Beyträge zur Beschreibung von St. Croix. Aus dem Dänischen." Copenh. 1794–8. The author mentions the following reptiles (p. 243):—

Testudo mydas, v. Green Turtle.

Testudo caretta, v. Caret or Lugger-head Turtle.

Testudo græca, v. Land Turtle. Rare.

Lacerta principalis (L.), v. Lizard. By this name, now applied to a North American species of *Anolis*, West designates the species which will be described hereafter.

Lacerta iguana, v. Guana.

Lacerta sputator, v. Slippery-back. This name is applied by West to *Mabouia ænea*.

Lacerta rapicauda, v. Wood-slave.

Lacerta. Ground Lizard.

No snake is mentioned by West. The following species are in the collection of Messrs. Newton:—

1. *Dromicus antillensis*, D. & B. (*Psammophis antillensis*, Schleg.).

There are four specimens of this species in the Collection, all showing exactly the same characters, although differing from a specimen from St. Thomas. They, like the latter, have eight upper labial shields, the third, fourth, and fifth of which come into the orbit. One temporal is in contact with the postocular, two others are behind the anterior temporal, and two or three more scale-like shields cover the posterior portion of the temporal region. Each scale is provided with two small pore-like impressions near the tip; they are of a lighter colour than the remainder of the scale. The coloration and the number of scales, however, is different: whilst the snake from St. Thomas has the body and tail light reddish-brown above, with more or less conspicuous darker stripes, the inferior parts dull yellowish, marbled with brown, and the scales in nineteen rows, the specimens from St. Croix have the upper parts saturated blackish brown, with equidistant reticulated yellowish transverse lines, the lower parts either of a pure yellow or with scattered irregular brown spots, and the scales in seventeen rows. There is a black streak through the eye, and a longitudinal groove between the labial and temporal shields, as in several species of *Dromicus*. Male and female are alike.

This snake appears to have been known to André-Pierre Ledru, who published a "Voyage aux Iles de Téneriffe, la Trinité, St. Thomas, Ste. Croix, et Porto-Ricco," Paris, 1810, 8vo, in two volumes. In a list of reptiles, which is less valuable for our purpose than that of West, because it contains *promiscuè* all the reptiles observed in the different islands, Ledru mentions "le cobel" (ii. p. 213). He says, "Le fond de sa couleur est tantôt gris, tantôt brun, mais communément d'un noir assez foncé, *avec une multitude de petites lignes blanches transversales.*" The latter character is far more applicable to the variety from St. Croix than to *Dromicus ater,* which may also be intended. Ledru observed his snake at the river Toa (Porto-Rico), and thinks it identical with *Coluber colubella,* Gm. (*Col. cobella,* L.).

"We regret that we have little information to give respecting this snake. It certainly is not very numerous in the island; for we never saw a living specimen, though we usually went about with our eyes well open. It would seem generally to frequent the waste in preference to the cultivated districts, or at least where there are most shrubs and bushes; but we have heard of one or more being found in a hole in the brickwork beneath the bed of a steam-engine-boiler. One of the specimens was captured in the town of Frederiksted."

The species and varieties of *Dromicus,* and their geographical distribution, are far from being known. There are several snakes in the Collection of the British Museum, which show considerable differences from the species to which they are referred for the present; of these, however, I have not the advantage of knowing the habitat, and each of them is represented by a single specimen only. I direct the attention of herpetologists especially to one of them, the anterior portion of the body of which is marked as in *D. rufodorsatus,* the posterior and the tail being black. The rostral shield is flat and obliquely ascending forwards; one anterior, two middle, and three posterior temporal shields; nineteen series of scales. Length 52 inches.

2. *Thecadactylus rapicauda,* Houtt.

"The *Thecadactylus* is not very common in St. Croix, chiefly frequenting old trees in the uncultivated portions of the island, though sometimes found in wood-cellars near houses. The statement of Dr. West, that it is regarded by the negroes with the greatest aversion, is perfectly true: they believe that, in case of one placing its foot upon them, it can only be got rid of by cutting off the piece of flesh upon which it has fastened. It is certainly difficult to kill, as one will bear the infliction of several sharp blows without much apparent harm being done to it. In St. Croix it is everywhere known as the 'Wood-Slave,'—an

appellation which, according to Mr. Gosse, is, in the leeward part of Jamaica, now applied to a species of *Mabouia* (Nat. Soj. p. 75); though it would appear, from what he elsewhere says, that by Sloane and others this term was used for some of the *Geccotidæ* (Proc. Z. S. L. 1848, p. 60; Ann. and Mag. N. H. 1850, p. 344)."

3. *Mabouia ænea*, Gray (*Eumeces marbouia*, D. & B., *Lacerta sputator*, West, not L.).

"The *Mabouia* is known in St. Croix as the 'Slippery-back;' and some of the dread which is inspired by the last-mentioned is also experienced of this species by the negroes. It is supposed to fasten upon the hand or other exposed part of the body with its mouth; and they assert that there is no way of making the creature let go its hold, save cutting it up, if it once seizes upon one. It is more plentiful than the *Thecadactylus*, but still not often observed. Two of the examples sent to the Museum were caught *in copulâ*."

4. *Anolis Newtoni*, n. sp. (Pl. IV. fig. A.)

?*Lacerta principalis*, West, not L.

Snout moderately elongate and depressed, with the canthus rostralis sharply prominent, and with a pair of ridges arising from the superciliary margins; a slight groove between these two ridges, another between each ridge and the canthus rostralis; loreal region rather concave, with five series of very small shields; the space between the orbits is covered with two series of shields only; occipital shield distinct. Scales on the sides of the body granular, gradually becoming larger towards the dorsal line and the belly, where they are distinctly keeled. No prominent dorsal crest, but two or three series of larger scales along the vertebral line. Pouch of the throat present, moderately developed. Tail slightly compressed, verticillated, above with a low serrated ridge, beneath with strongly keeled scales of equal size. Greenish olive (in spirits), irregularly spotted with blackish brown on the sides and on the posterior parts of the hinder extremity. Female sometimes with a broad whitish dorsal streak, crossed by narrow black bars.

Description.—The snout is moderately depressed and slightly elongate, the distance between the two anterior angles of the orbit being three-quarters of the distance between the orbit and the extremity of the snout; anteriorly it is rather narrow and rounded. The canthus rostralis is sharp and rather prominent; and there is another pair of low divergent ridges, arising from the superciliary margin of the bony orbit, and extending to the

middle of the length of the snout; between these ridges is a shallow groove, and another, narrower, between each ridge and the canthus rostralis. There is a series of larger shields along the superciliary margin and the ridge; no other smaller shields occur between the superciliary series, but many in and before the central groove of the upper surface of the snout. The canthus rostralis is formed by a series of elongate shields, angularly bent; two shields between the latter series and that of the interior ridge. The nostril opens laterally, between several small shields, above the anterior extremity of the canthus rostralis. The canthus rostralis is continued along the outer margin of the roof of the orbit, which is provided with a group of five or six polygonal shields, surrounded by minute granulations. There is an ovoid occipital shield in immediate contact with the suture between the superciliary series, and surrounded by a great many smaller shields. The loreal region is slightly concave, with five longitudinal series of small oblong shields. The rostral shield has posteriorly five notches (to receive five small shields), of which the middle one is the deepest; seven very narrow labials, with two or three minute ones behind, form the lateral margin of the upper jaw. The anterior extremity of the lower jaw is covered with a pair of rather broad labials, its margin with seven narrow shields; three other series of smaller shields run parallel to that of the labials. The chin and all the throat are covered with very small granular scales.

The tympanum is a rather small cleft, without any particular scales round its margin; the scales on the temple are exceedingly small.

Immediately behind the occipital shield commences the streak of larger vertebral scales; they are arranged in two or three series, and keeled like the other scales on the back. They gradually become smaller towards the sides, in the middle of which they form minute granulations. Those of the belly are distinctly keeled, and larger than those of the back; they are largest on the sides of the pouch, where they are arranged in very oblique series. The pouch is present in both sexes, but it forms a slight fold only in the female. The scales round the vent do not show any peculiarity, and are granular.

The vertebral streak of scales is continued on the tail into a low serrated crest, formed by a single series of scales. The tail is slightly compressed and rounded beneath, verticillated; the single verticils are distant from each other for four scales of the caudal crest, the fourth scale always being larger than the three preceding ones. The sides of the tail are covered with granular scales, whilst the scales of its lower surface are very large and strongly keeled; the root of the tail is slightly swollen

and provided with small scales in its whole circumference, except on the dorsal crest.

The fore leg reaches, if laid backwards, to the loin; it is covered with keeled scales on the superior and anterior sides, with granulations on the inferior and posterior. The inner finger is not dilated, the fourth and fifth are of equal size. The hind leg reaches, if laid forwards, to the anterior margin of the orbit; it is covered anteriorly with keeled scales, all the rest being granular.

The ground-colour is now greenish-olive, in life apparently greenish, shining golden and bluish; most of the specimens have the sides of the neck and of the trunk and the posterior part of the limb irregularly dotted with blackish-brown. One of the females (caught with the male during the act of copulation) has a broad dorsal streak, crossed by narrow black bars. The lower parts are uniform yellowish-white.

The females are only half the size of the males. All the females had one egg only in the oviduct, those of the ovarium showing no sign of development: it is very large compared with the size of the animal; and there was no trace of embryo in it, although it appeared to be ready for laying. This observation seems to be in contradiction to the abundance of these Tree-lizards; but it may be possible that they breed several times in every season, and that a single egg only is impregnated by one act of copulation.

	Male. inches.	Male. lines.	Female. inches.	Female. lines.
Distance between tympanum and the extremity of the snout	0	8½	0	6
Distance between tympanum and vent	1	6¾	1	3½
Length of the tail	4	6	3	6
Distance between the bony orbital margins	0	1	0	0½
„ the anterior angles of the orbit	0	3	0	2
„ the orbit and the extremity of the snout	0	4	0	3½
Length of the humerus	0	5	0	3½
fore-arm	0	4¼	0	3¼
second and fifth fingers	0	2½	0	2
third and fourth fingers	0	4	0	3
fore leg	0	6½	0	5
hind leg	0	6¾	0	5
fourth toe	0	7½	0	6
fifth toe	0	3½	0	2¾

"The *Anolis* is exceedingly abundant, and its great familiarity affords excellent opportunities of studying its manners; but Mr. Gosse has already described the habits of the two Jamaica species, *A. iodurus* and *A. opalinus*, so fully (Nat. Soj. pp. 216 *et seq.*), that we have little more to say of those of the present than that they seem entirely to resemble the former: at any

rate, the differences are probably only such as would be appreciated by one who has had the opportunity of observing all three. But we must bear witness to the extreme fidelity of Mr. Gosse's notes—not a word of them but seems to be literally and entirely true; and especially must we remark on his account of the 'goître' in the species of this genus, the mechanical method of displaying it practised by the animal, and its unvarying colour, all of which is as accurate as the use of that remarkable appendage is to us at present unknown. The brilliancy, however, of this orange disk varies in different individuals. To describe generally the hues of the rest of the body would be impossible,—they are simply those of the rainbow, though never of any great intensity, excepting when, in an irritated or alarmed animal, the prevailing tint, whatever it may have been before, becomes a dull smoky brown. This species is much fed upon by birds: a young Bare-legged Owl (*Gymnoglaux nudipes*) which one of us possessed would scarcely eat anything else; and when offered to it alive, these lizards would make a resistance which often ended in their escape ('Ibis,' 1859, p. 65): we have found their remains also in the stomachs of other birds, especially in the Green Heron (*Butorides virescens*), which seems constantly to prey upon them. The food of the species seems to consist chiefly of ants. There is one peculiarity about it which Mr. Gosse has not recorded,—and that is, that if a small pebble, the size of a pea or so, be thrown near where an *Anolis* is sitting, it will run after it, probably under the idea that it is a living creature. Among the specimens of this species sent to the Museum were a pair taken *in copulâ*."

5. *Sphærodactylus macrolepis*, n. sp. (Pl. IV. fig. B.)

Body surrounded by about forty longitudinal series of scales of rather large size; no vertebral streak of smaller ones, those of the back keeled, of the belly smooth. Trunk and tail uniform blackish-brown, in younger individuals some scales with blackish tips; head greyish-brown, marbled with black; jaws and throat striolated with blackish.

Description.—The snout is of moderate extent, and slightly pointed; all the upper surface of the head and the sides are covered with scales of moderate size; there is an exceedingly small horn-like spine above the middle of the orbit. The rostral shield is low, and bent backwards on the upper surface of the snout; the sides of the jaw are margined with three elongate labials; the nostril is situated above the posterior extremity of the rostral shield and the first labial, and exceedingly small. The anterior lower labial is single; a series of three other shields covers the lateral margin of the lower jaw. The scales of the

throat are small, those of the breast and of the extremities keeled. The ear-opening is very small, one-third only of the width of the eye. The fingers and the toes have an entire and unarmed disk. The tail is covered with smooth scales, rather smaller than those of the trunk; there is a series of larger ones, plate-like, along the lower medial line. No femoral or anal pores.

I add to the statement of the coloration given above, that the belly is uniform dirty white, and the tail minutely dotted with blackish. Two specimens were in the Collection.

	lines.
Distance between the extremity of the snout and the tympanum	$2\frac{3}{4}$
„ tympanum and the vent	$9\frac{1}{3}$
Length of the tail	13
„ fore leg	$3\frac{1}{2}$
„ hind leg	$4\frac{1}{3}$

"Of the *Sphærodactylus* all we have to say is that it is not very common. The specimens were captured in houses; but we are inclined to believe it chiefly frequents the fields, and especially the cane-pieces."

"There are at least two other Reptiles in St. Croix, of which we regret to say we did not bring home examples.

"One is a Frog, of which we have never seen a living individual, though it is very abundant, and may be heard at almost all times of the night or day, by the side of every spring or stream, where it is especially noisy in the mornings and evenings. The cause of its invisibility is doubtless owing to its subterranean habits, and probably also to the fact, as Dr. Günther has well suggested, that when a sound proceeds from on or beneath the surface, the vibrations are communicated to the ground equally in every direction; so that there are but few ears so acute as to detect the exact spot whence the noise issues. Instances of this sort are well known to naturalists; and one need only mention the cases of a Shrew, a Grasshopper Warbler (*Sylvia locustella*), or a Cricket, to refer to a sufficient proof of the fact. The cry of these frogs is somewhat similar to the noise made by air-bubbles escaping from a small tube under water, but with a deep metallic ringing about it; and constantly as we have heard, and often as we have tried to discover the whereabouts of the musicians, we have failed to do so. After floods, it is said that, the holes inhabited by these animals being destroyed, they may easily be captured; but without some such favouring circumstances (which did not happen to us) any endeavour of the kind seems hopeless.

"The other animal of which we did not bring home a specimen is a large lizard, called in the island a 'Guana,' possibly

a species of *Iguana*. An example seen by one of us was about 4 feet long, with a large dewlap and high dorsal crest extending down the back. It appears now to be restricted only to the eastern end of the island."

Mr. Rüse, of St. Thomas, has sent, during the printing of this paper, two bottles containing frogs from that island. One is marked *Hylodes martinicensis*, the other, *Cystignathus ocellatus*. After a careful examination and comparison with the other species of *Hylodes* and *Cystignathus*, I have convinced myself that both belong to one and the same species, and that those named *C. ocellatus* are merely the young of the other. The toes are not at all dilated; and the frogs belong to a new species of *Cystignathus*, which I call

Cystignathus albilabris.

Tympanum distinct, one-half the size of the eye. Vomerine teeth in two short series, behind the level of the interior nostrils. Tongue very slightly nicked posteriorly. Skin smooth, with an indistinct longitudinal fold on each side; a transverse fold between the fore-legs, another across the posterior third of the belly. Snout moderately produced. Tarsus with a longitudinal fold; interarticular tubercles prominent. Male with two vocal sacs, communicating with each other, each with a separate slit. A white or whitish streak round the snout to the axil.

Colour of the adult:—Above uniform dark bluish-black; the upper leg with some black cross-bars superiorly, and some whitish spots posteriorly. The lower parts white, the throat speckled with brown. The labial streak whitish, indistinct below the eye.

Colour of the young:—Brownish-olive marbled with darker; uniform white inferiorly; the labial streak white, very distinct.

These descriptions of the colours are taken from quite fresh specimens in spirits.

Hab. St. Thomas. The specimens are now in the British Museum.

XXIII.—*Characters of some apparently undescribed Ceylon Insects.* By F. Walker.

[Continued from vol. iii. p. 265.]

Fam. Curculionidæ.

Desmidophorus discriminans. Ferrugineus, crassus, rostro robusto nigro nitente striato coxas anticas attingente, thorace tuberculato, elytris rude lineato-tuberculatis, vix dimidio apicali testaceo-albido, femoribus albido fasciatis. Long. 5 lin.

Desmidophorus fasciculicollis. Ferrugineus, crassus, rostro robusto nigro nitente basi punctato coxas anticas attingente, thorace tuberculis duobus dorsalibus fasciculatis, elytris tuberculis nonnullis nigricantibus fasciculatis, fasciis duabus incompletis albidis, femoribus albido fasciatis. Long. 3 lin.

Camptorhinus reversus. Niger, fusiformis, lateribus pectore ventre pedibusque cinereo-tomentosis, rostro nitente femoribus anticis non breviore basi punctato et cinereo, thorace conferte punctato, elytris punctato-striatis, lituris duabus posticis angulatis albidis, femoribus crassis unidentatis. Long. 4 lin.

Camptorhinus indiscretus. Piceus, longi-fusiformis, cinereo-tomentosus, rostro rufo nitente femoribus anticis non breviore apice nigro basi punctato et cinereo, thorace conferte punctato, elytris punctato-striatis nigro et cinereo variis, femoribus crassis unidentatis. Long. 3¾ lin.

Sipalus? porosus. Niger, subfusiformis, rostro nitente subcylindrico basi punctato et substriato femoribus anticis vix longiore, thorace ruguloso, elytris asperrime punctato-striatis apices versus bituberculatis, femoribus crassis subtus unidentatis. Long. 8 lin.

Sipalus? tinctus. Ferrugineo-fuscus, fusiformis, rostro nigro subcylindrico striato basi fusco apicem versus nitente femoribus anticis paullo breviore, thorace tuberculato, elytris lineato-subtuberculatis, pedibus subtuberculatis, femoribus non dentatis. Long. 9 lin.

Rhynchophorus introducens. Niger, velutinus, subtus nitens, rostro nitente striato, antennis piceis basi nigris, thorace obsolete olivaceo postice conico, elytris striatis, abdominis apice truncato-conico, femoribus basi tibiisque subtus aurato-pubescentibus, tarsorum articulo 4° dilatato subtus aurato-pubescente. Long. 18 lin.

Sphenophorus glabridiscus. Niger, nitens, fusiformis, rostro punctato, thoracis disco plano, lateribus pectoreque punctatis, elytris punctato-lineatis, abdominis apice cinereo punctato. Long. 7 lin.

Sphenophorus cribricollis. Niger, nitens, fusiformis, rostri dimidio basali punctato, antennis apice cinereis, thorace confertissime punctato, elytris punctato-lineatis. Long. 5 lin.

Sphenophorus exquisitus. Niger, obscurus, longi-fusiformis, rostro nitente glabro vix arcuato basi punctato, thorace subtilissime punctato, elytris scitissime punctato-lineatis luteo quadrimaculatis. Long. 2¾ lin.

Sphenophorus? panops. Niger, subtus testaceo-tomentosus, rostro nitente glabro, oculis supra contiguis, antennis rufis, thorace subtilissime punctato, elytris scite punctato-lineatis, macula trigona basali apiceque testaceo-albidis, fasciis duabus obliquis canescentibus, pedibus cano-tomentosis. Long. 2½ lin.

Cossonus? hebes. Niger, obscurus, longi-fusiformis, rostro brevi lato, thorace subtilissime punctato, elytris scite punctato-lineatis. Long. 2¼–2½ lin.

Cossonus quadrimacula. Niger, fusiformis, rostro sat tenui, thorace confertissime punctato, elytris scite punctato-lineatis. Long. 1¼ lin.

Sitophilus disciferus. Niger, nitens, rostro brevi lato, thoracis disco concavo rude punctato, elytris rufis scite lineato-punctatis apices versus nigris. Long. 1¼–1¾ lin.

Mecinus? relictus. Ater, ellipticus, nitens, rostro tenui glabro coxas intermedias attingente, thorace scitissime punctato, elytris subtilissime punctato-lineatis. Long. 1¼–2¼ lin.

Fam. Coccinellidæ.

Coccinella tenuilinea. Nigra, capite testaceo macula discali nigra, thorace testaceo, margine postico maculisque duabus margine connexis maculisque duabus anticis lateralibus nigris, elytris rufis margine tenuissimo nigro. Long. 1⅓ lin.

Coccinella rejiciens. Rufa, corporis subtus disco nigro, thorace macula discali nigra, elytris plagis duabus posticis transversis maculisque duabus apicalibus nigris. Long. 2 lin.

Coccinella interrumpens. Rufo-fulva, elytris vittis tribus bis-interruptis nigris. Long. 1⅓ lin.

Coccinella quinqueplaga. Rufo-fulva, capitis thoracisque discis nigris, elytris sutura plaga discali plagaque apicali nigris. Long. ¾ lin.

Coccinella simplex. Testacea, pubescens, oculis nigris. Long. ⅓ lin.

Coccinella antica. Rufescenti-testacea, thorace maculis tribus nigris, elytris glabris. Long. ⅔ lin.

Coccinella? flaviceps. Nigra, pubescens, capite pedibusque flavescentibus, elytris subtilissime punctatis. Long. ¾ lin.

Scymnus variabilis. Niger, elytris lutescentibus vitta lata suturali vittisque duabus marginalibus nigris postice abbreviatis. Long. ⅓ lin.

Chilocorus opponens. Rufescens, thorace plaga discali maculisque duabus lateralibus nigris, elytris nigris plagis duabus discalibus anticis nigris. Long. 2 lin.

Fam. Endomychidæ.

Lycoperdina glabrata. Fulvescens, elytris subtilissime punctatis. Long. 1⅓ lin.

Addenda.

Sisyphus prominens. Niger, obscurus, capite rude punctato, clypeo angulato bidentato, thorace conferte punctato, elytris rude lineatis et foveatis, femoribus posticis basi coarctatis. Long. 3⅓ lin.

ORPHNUS SCITISSIMUS. Ater, subtus pilosus, capite conferte punctato postice glabro, antennis testaceis, thorace subtilissime punctato, elytris scitissime punctato-lineatis, pedibus robustis fortissime dentatis. Long. 4 lin.

RHIZOTROGUS SULCIFER. Piceo-rufus, antennis elytris corpore subtus pedibusque testaceis, capite thoraceque rude punctatis, elytris conferte punctatis, sulcis sex basalibus. Long. 6 lin.

PLECTRIS GLABRILINEA. Piceo-ferruginea, viridi subnitens, conferte punctata, non pilosa, antennis fulvis, elytrorum foveis duabus humeralibus, lineis tribus glabris. Long. 4¼ lin.

PLECTRIS PUNCTULIGERA. Cupreo-picea, pilosa, conferte et rude punctata, antennis lutescentibus, elytrorum foveis duabus humeralibus, lineis tribus glabris. Long. 3½–4 lin.

ANOMALA INFIXA. Cupreo-viridis, confertissime punctata, capite antico corpore subtus pedibusque viridi-ferrugineis, thorace foveis duabus lateralibus rotundis, elytris scite punctato-lineatis, tuberculis duobus subapicalibus fuscis. Long. 5 lin.

MIMELA MUNDISSIMA. Saturate viridis, subtilissime punctata, subtus rufescens, capite antico thoracis et elytrorum lateribus viridescenti-flavis, antennis lutescentibus, pedibus viridi-rufis. Long. 7 lin.

TROPIDERES FRAGILIS. Niger, capite testaceo-pubescente, antennis gracillimis, thorace plaga antica maculisque duabus discalibus testaceis, elytris striatis, maculis duabus humeralibus punctisque testaceis, pedibus ferrugineo variis. Long. 2 lin.

Order ORTHOPTERA.

Fam. Blattidæ.

PANESTHIA PLAGIATA. Nigra, lata, robusta, rude punctata, capite glabro, thoracis sulco transverso arcuato, elytris costa basi dilatata, fascia brevi lata obliqua testacea.

Black, broad, stout, roughly and irregularly punctured. Head smooth. Thorax with a curved transverse furrow. Legs very stout and spinose. Elytra with the costa dilated towards the base, near which they are minutely punctured, and have a broad, short, oblique testaceous band, which is abbreviated hindward. Length of the body 13 lines.

Fam. Mantidæ.

HARPAX SIGNIFER. Fulvus, oculis subcornutis, thorace marginato antice carinato postice conico lateribus subdilatatis, pedibus anticis incrassatis spinosis, alis anticis pallide viridibus basi fulvis annulo discali nigro biguttato.

Tawny. Head ridged on the face. Eyes produced and slightly diverging, conical or somewhat cornute, with a protuberance between them. Thorax with an elevated border, keeled in front,

slightly dilated in the middle, conical hindward. Fore legs incrassated, spinose. Fore wings pale green, tawny towards the base; middle part with a large black ringlet which contains two black dots. Length of the body 10 lines.

Fam. Gryllidæ.

ACHETA SUPPLICANS. Sordide testacea, capitis margine postico discoque antico nigricantibus, thoracis margine postico fasciaque incompleta nigricantibus, oviductu longo, alis lanceolatis, anticis fuscescentibus, posticis longissimis.

Dingy testaceous. Head blackish behind and on the disk in front. Thorax with a slight longitudinal furrow, blackish along the hind border, and with an irregular and incomplete blackish band. Abdomen blackish above; ovipositor longer than the abdomen; caudal setæ very bristly, as long as the ovipositor. Legs with slight blackish marks; hind tibiæ very spinose. Fore wings brownish, lanceolate. Hind wings lanceolate, pale testaceous, twice the length of the fore wings. Length of the body 6 lines.

ACHETA ÆQUALIS. Pallide testacea, capitis disco nigro semicirculum testaceum includente, lituris inter antennas duabus nigris, thorace fascia arcuata liturisque duabus capitatis nigris, pedibus crassis, tibiis nigro-fasciatis, alis anticis longissimis nigro-venosis.

Pale testaceous. Head black above, including a pale testaceous semicircle, and with two black marks between the antennæ, which are tawny, except at the base. Thorax with a curved hindward black band which is attenuated on each side, and projects a streak, on each side of which there is an irregular capitate black mark. Legs very stout; tibiæ with black bands. Fore wings very long, with brown reticulations. Length of the body 8 lines.

ACHETA CONFIRMATA. Cervina, capitis disco nigro lineam transversam maculamque anticam testaceas includente, abdomine supra nigricante, alis anticis parvis, posticis longis lanceolatis testaceis.

Fawn-colour. Head shining, with a black disk, which includes a transverse testaceous line behind the antennæ and a testaceous spot between them. Thorax minutely rugulose, and with a slight suture, which is obsolete hindward. Hind legs very stout; tibiæ with thick spines. Abdomen blackish above; setæ bristly, shorter than the abdomen. Fore wings short. Hind wings testaceous, lanceolate, fully twice the length of the hind wings. Length of the body 6 lines.

PLATYDACTYLUS CRASSIPES. Rufescens, glaber, capite subconico, antennis fulvis longis subpubescentibus, palpis testaceis, pedibus testaceis crassis, tibiis anticis spinosis, alis breviusculis pallide fuscescentibus.

Reddish, smooth. Head somewhat conical. Antennæ tawny, very long, minutely pubescent. Palpi testaceous. Legs testaceous, very stout, with a few slight blackish marks; fore tibiæ

with stout spines. Wings pale brownish, rather short; hind wings a little longer than the fore wings. Length of the body 12 lines.

Steirodon lanceolatum. *Fœm.* Testaceo-viride aut pallide viride, longa, gracilis, capite conico, antennis longis, thorace rectangulato, abdomine brevi, oviductu falcato, alis longis angustis, anticis albido-hyalinis apice viridescentibus.

Female. Testaceous green or pale green, long, slender. Head conical, with a reddish band on the vertex. Antennæ long and slender. Thorax rectangular, much longer than broad. Abdomen short. Oviduct short, broad, falcate, much compressed. Legs long and slender. Wings long and narrow. Hind wings whitish hyaline, greenish at the tips, longer than the fore wings. Length of the body 8 lines, of the wings 24 lines.

Truxalis exaltata. Viridescenti-testacea, capite cornu longum lanceolatum elevatum subobliquum fingente, oculis valde elongatis, thorace tricarinato, pectore ventrisque dimidio basali nigricantibus, alis longis angustis, anticis viridibus, posticis hyalinis.

Greenish-testaceous. Head produced into a long, ascending, slightly oblique horn. Eyes much elongated, near the tip of the horn. Thorax with three ridges. Pectus blackish. Abdomen long, black beneath for half the length from the base. Hind legs very long. Wings long and narrow. Fore wings green. Hind wings hyaline. Length of the body 20 lines.

Truxalis porrecta. Ferruginea, nigricante varia, capite porrecto lanceolato vix ascendente antice sulcato, antennis compressis, alis abdomen sat superantibus, posticis cinereis.

Ferruginous, with various blackish marks. Head porrect, lanceolate, hardly ascending, rounded and slightly bilobed in front. Antennæ flattened, hardly longer than the head. Thorax longer than the head. Abdomen obtuse and vertically expanding at the tip. Wings extending some distance beyond the abdomen. Hind wings grey. Length of the body 10 lines.

Acrydium extensum. Testaceum, fulvo varium, capitis fronte vittaque nigricantibus, antennis luteis apice fuscis, thorace punctato unicarinato vittis tribus nigris, alis cinereis, anticis subluridis nigricante notatis.

Testaceous, partly tawny, more greenish when living. Head blackish in front, and with a blackish stripe, which contains a slight testaceous keel, and has a row of black points along each side. Antennæ luteous, brown towards the tips. Thorax roughly punctured, with a slight blackish keel, and with a black stripe on each side. Wings grey. Fore wings with a lurid tinge, with slight blackish marks; veins tawny. Length of the body 20 lines.

Acrydium deponens. Testaceum, capite vittis duabus nigricantibus, antennis luteis apice fuscescentibus, thorace fuscescente tri-

carinato, pedibus anterioribus fuscescentibus, femoribus posticis extus nigro vittatis, spinis tibiarum posticarum albis apice nigris, alis cinereis, anticis fusco notatis postice luridis.

Testaceous. Head with two blackish stripes, which diverge slightly hindward. Antennæ luteous, with brownish tips. Thorax mostly brownish, with three keels, the middle one very slender. Anterior legs brownish. Hind legs testaceous; femora with a black stripe on the outer side, which, as usual, has an elevated border and angular sutures; tibiæ with strong white black-tipped spines. Wings grey. Fore wings with various brown marks, lurid along the hind border. Length of the body 15 lines.

Acrydium rufitibia. Obscure cervinum, antennis testaceis, thorace subruguloso supra nigricante unicarinato, femoribus posticis fuscis subtus testaceis, tibiis tarsisque posticis læte rufis, alis anticis subcervinis apud costam nigricantibus, posticis cinereis.

Dull fawn-colour. Antennæ testaceous. Thorax minutely rugulose, blackish above, with a very slight middle keel. Hind femora brown, testaceous beneath; outer side as in *A. deponens*; hind tibiæ and hind tarsi bright red, the former with pale black-tipped spines. Fore wings dull fawn-colour, blackish along most of the costa. Hind wings grey. Length of the body 16 lines.

Acrydium respondens. Cervinum, nigro conferte notatum, femoribus posticis extus glaucescentibus, tibiis posticis læte rufis, alis anticis nigris testaceo notatis, posticis cinereis.

Fawn-colour, thickly marked with black. Antennæ mostly blackish, except towards the base. Hind femora with a glaucous tinge, and with the usual structure on the outer side; hind tibiæ bright red. Fore wings black, with various testaceous marks. Hind wings grey. Length of the body 10–12 lines.

Acrydium cinctifemur. Cervinum, tuberculatum, nigro varium, subtus testaceum, pedibus nigro fasciatis, tibiis posticis glaucis basi nigris testaceo fasciatis, alis anticis nigris testaceo variis, posticis cinereis.

Fawn-colour, varied with black, tuberculate, testaceous beneath. Head and antennæ mostly black. Legs with black bands. Hind femora of the usual structure; hind tibiæ glaucous, black and testaceous towards the base. Fore wings black, varied with testaceous. Hind wings grey. Length of the body 10 lines.

Acrydium? nigrifascia. Sordide testaceum, oculis valde extantibus, thorace plano tricarinato fascia lata nigra, pedibus nigro variis, tibiis posticis basi albidis, alis anticis nigro variis.

Dingy testaceous, tinged with green. Eyes extremely prominent. Thorax somewhat flat above, with a broad black band, and with three keels; the lateral keels angular. Legs of the usual structure, varied with black; hind tibiæ whitish at the base. Fore wings varied with black. Length of the body 4 lines.

Order PHYSAPODA.

PHLŒOTHRIPS STENOMELAS. Ater, antennis concoloribus, capite glabro, thorace striis transversis, abdomine lineari apice lanceolato.

Deep black. Antennæ submoniliform. Head smooth, nearly as long as the thorax, which is transversely striated. Abdomen linear, lanceolate at the tip. Fore legs thick. Length 1¾ lin.

XXIV.—*Descriptions of two new Species of American Parrots.* By PHILIP LUTLEY SCLATER, M.A., Secretary to the Zoological Society.

1. *Conurus holochlorus.*

Læte viridis unicolor; subtus dilutior: remigibus et rectricibus infra saturate flavicanti-olivaceis: rostro albo: pedibus clare brunneis.
Long. tota 11·0, alæ 6·5, caudæ 5·5.
Hab. in vicinitate urbis *Jalapa* in rep. Mexicana.

The large collection of birds made in the vicinity of Jalapa, in the Mexican State of Vera Cruz by Señor Rafael Montes de Oca, contained four examples of this Parrot,—the first which have come under my notice. It is a close ally of *Conurus pavua* (Bodd.) (*Psittacus guianensis*, Gm.), but readily distinguishable by the absence of red and yellow on the under wing-coverts, which are green like the body.

The Parrots of which I have now seen examples undoubtedly from Mexico, are the following:—

1. *Rhynchopsitta pachyrhyncha* (Sw.), Phil. Mag. 1827, p. 429. *Hab.* Table-land of Mexico from Rio Grande into State of Vera Cruz.
2. *Conurus holochlorus*, Sclater. *Hab.* Vicinity of Jalapa, *probably* table-land.
3. *Conurus Petzii*, Hahn, Papag. t. 64. *Hab.* Tierra caliente of Vera Cruz; Acapulco (Boucard).
4. *Conurus astec*, Souancé, Rev. Zool. 1856, p. 154. *Hab.* Tierra caliente of Vera Cruz; Cordova (Sallé).
5. *Conurus lineolatus* (Cassin); *Psittacula lineola*, Cass. Pr. Ac. Sc. Phil. vi. 372. *Hab.* Vera Cruz, vic. of Cordova (Sallé).
6. *Pionus senilis* (Spix); *Ps. leucorhynchus*, Sw. *Hab.* Vera Cruz, vic. of Cordova (Sallé).
7. *Chrysotis ochroptera* (Gm.) *Hab.* Tierra caliente of Vera Cruz (Sallé),
8. *Chrysotis viridigenalis*, Cassin, Pr. Ac. Sc. Phil. vi. 371. *Hab.* Tierra caliente of Vera Cruz (Sallé).
9. *Chrysotis æstivalis*, Bp. MS.; *C. autumnalis*, Sclater, P. Z. S. 1857, p. 205. *Hab.* Tierra caliente of Vera Cruz.

I have not yet been able to identify the two Aras (spoken of, Pr. Zool. Soc. 1857, p. 230); but one, without doubt, is *Ara macao* (Linn.) (*aracanga*, Gm.), which is common on the Pacific coast-region of Honduras*.

2. *Conurus xantholæmus.*

Læte viridis, pileo summo cærulescente; fronte lato, oculorum ambitu, lateribus capitis et gula aurantiaco-flavis: pectore fulvescente: abdomine et tectricibus alarum inferioribus pallide flavo-viridibus, ventre medio aurantiaco-flavo: remigibus alarum intus fusco-nigris, extus cærulescenti-viridibus; cauda subtus flavicanti-olivacea, supra dorso concolore, apicem versus cærulescente; rostro nigro, pedibus nigricantibus.
Long. tota 9·5, alæ 5·30, caudæ 4·30.
Hab. in insula Sancti Thomæ, Antillensium.

I am indebted to my friends Alfred Newton, Esq., and his brother Edward, who have done so much to increase our knowledge of the natural productions of the islands of St. Croix and St. Thomas, for an opportunity of examining and describing this apparently hitherto unnoticed species of *Conurus*. The existence of this Parrot in St. Thomas has been known to Mr. Newton for some time; but it is only recently that he has succeeded in obtaining specimens of it.

This *Conurus* is of the same form as, and closely allied to, *Conurus pertinax* of Brazil, *C. chrysophrys* of Guiana, and *C. chrysogenys*† of Trinidad, but differs in one particular or the other from each of them. Like *C. chrysogenys*, it has a blue band on the top of the head, but it may be at once distinguished from that bird (perhaps its nearest ally) by the orange-yellow extending over the throat.

The Parrots of the Antilles, like the other animals inhabiting those islands, seem to have a very limited geographical distribution, each island producing peculiar forms, which, though not always separated by trenchant characters from their correspondents in the other islands, generally present such differences as seem to require specific distinction.

This is the case amongst the Mammalia in the genus *Capromys*; amongst the birds in the genera *Lampornis, Todus, Spindalis, Saurothera* and others; amongst the Reptiles in the genera *Dromicus* and *Anolis*. Were the fauna of the Antilles properly worked out, there is no doubt that numerous other instances would be found of this geographical arrangement of species.

* See Mr. Salvin's remarks in 'The Ibis,' 1859, p. 137.

† Of M. de Souancé, but subsequently reunited by him to *Psittacus æruginosus* of Linnæus. This identification I am inclined to consider doubtful.

I subjoin a list of the Parrots now known to inhabit the different islands of the group:—

Cuba.	Jamaica.	St. Domingo.
Ara tricolor?	Ara tricolor?	
Conurus euops.	Conurus nanus.	Conurus chloropterus.
Chrysotis leucocephala.	Chrysotis collaria.	Chrysotis Sallæi.
—— cyanorhyncha?	Chrysotis jamaicensis?	
	—— agilis.	

Porto Rico.	St. Thomas.	St. Vincent.
Conurus Maugæi.	Conurus xantholæmus.	
Chrysotis vittata.		Chrysotis Guildingii.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

March 24, 1859.—Sir Benjamin C. Brodie, Bart., President, in the Chair.

"On the Vertebral Characters of the Order Pterosauria (Ow.), as exemplified in the genera *Pterodactylus* (Cuv.) and *Dimorphodon* (Ow.)." By Prof. Owen, F.R.S.

After mentioning various considerations which have tended to invest the question of the vertebral characters of the Pterodactyles with peculiar interest—above all, in reference to carrying out the comparison of their skeleton with that of birds—the author alludes to the scanty information on the subject already on record, which—with the exception of a remark of Professor Quenstedt as to the apparently procœlian characters observed by him in a dorsal vertebra of *Pterodactylus Suevicus*, and the apparent want of the trochlear form in the cervical articulations of that animal—affords no available data for comparing the vertebral mechanism of these reptiles with that of other vertebrata adapted for flight; he then gives a summary of his own observations, made, as opportunities presented themselves, for some years past.

From investigations of species of *Pterosauria* extending from the period of the Lias, as exemplified by the *Dimorphodon macronyx*, to the upper greensand, as exemplified by the *Pterodactylus Sedgwickii* and *Pter. Fittoni*, the author has ascertained the fact that, with respect to the cervical and dorso-lumbar vertebræ, the terminal articular surfaces of the vertebral bodies are simply concave anteriorly and convex posteriorly, and that they consequently manifest the earliest known instance of the "procœlian" type which now prevails in the reptilian class. But in no other reptile are those articular surfaces so narrow vertically, in proportion to their breadth, as they are in the cervical vertebræ of the *Pterosauria*: in the dorsal series the cup and ball present more ordinary Saurian proportions.

Besides these principal and more general characters, those also which distinguish the vertebræ of the several regions of the spine, together with the specialities of the atlas and axis, and of other individual vertebræ, are pointed out and described.

April 14, 1859.—Sir Benjamin C. Brodie, Bart, President, in the Chair.

"On the means by which the *Actiniæ* kill their Prey." By Augustus Waller, M.D., F.R.S. In a Letter to Dr. Sharpey, Sec. R. S.

In the 'Proceedings of the Royal Society' for the 18th November, p. 478 *, I perceive that Dr. M'Donnell's fresh observations on the Actiniæ have led him to abandon the opinion which he had been disposed to entertain as to their possessing electrical powers similar to those of the torpedo. During a stay at the sea-side in the winter of 1857–58, I put in hand some experiments for the purpose of testing the supposed electrical powers of these animals, which, as I some months since mentioned to you, led me to negative conclusions relative to their siderant power. Dr. M'Donnell's recent observations having removed any occasion of controversy, I will briefly mention the results that I obtained.

The most interesting fact observed by Dr. M'Donnell is the contraction of the galvanoscopic frog when the Actinia seized upon the sciatic nerve. On repeating this experiment, I was particularly struck by the uncertainty and irregularity with which these contractions were obtained, being sometimes very strong, while at others they were imperceptible notwithstanding all the precautions that I could take as to the frogs being fresh caught and irritable, besides attending to the rules laid down by Matteucci.

On the other hand, when, in lieu of a galvanoscopic frog, I presented a Nereis to the Actinia, the result was invariably the death of the animal. The effect of the Actinia's grasp upon the Annulata is mortal, although the retention may not have been allowed to exceed a few moments. The first symptom which I observed was that of writhing, as if the creature were in great pain, and which in the most marked cases was succeeded by paralysis with flaccidity of the muscles, like a frog acted upon by woorara. The action of the dorsal vessel, which still persisted long after the loss of voluntary power, was very irregular and segmental, the vessel being bloodless and inert at intervals.

It appeared indifferent whether the cephalic or the caudal extremity of the Nereis was attacked by the Actinia, similar symptoms being produced in both cases.

In order to ascertain how far these symptoms were produced by electricity, I subjected the Nereis enclosed in a glass tube to some violent shocks by means of an electro-magnetic machine, which were merely productive of a slight temporary inconvenience to the animal, unattended by any after evil effects. It is most remarkable what powerful electric action these creatures are susceptible of enduring

* Ann. Nat. Hist. ser. 3. vol. iii. p. 304.

without injury; the strongest action of an electro-magnetic machine on Du Bois Reymond's principle, which affected myself violently up to the elbows, appeared to be easily endured by them.

The above experiment is quite sufficient to show how impossible it is to attribute the fatal influence of the Actiniæ to simple electrical action.

In order to elucidate the real power of the Actiniæ—after having in vain exposed the finger on which the cuticle had been softened by soaking in water—considering that the tongue was better adapted for the purpose in view, by reason of the thinness of its cuticle, I presented its apex to the tentacles of an *Actinia mesembryanthemum*, of about the size of a half-crown piece. The result was such as to satisfy the most sceptical respecting the offensive weapons with which it is furnished. The animal seized the organ most vigorously, and was detached from it with some difficulty after the lapse of about a minute. Immediately a pungent acrid pain commenced, which continued to increase for some minutes until it became extremely distressing. The point attacked felt inflamed and much swollen, although to the eye no change in the part could be detected. These symptoms continued unabated for about an hour, and a slight temporary relief was only obtained by immersing the tongue in cold or warm water. After this period the symptoms gradually abated, and about four hours later they had entirely disappeared. A day or two after, a very minute ulceration was perceived over the apex of the tongue, which disappeared after being touched with nitrate of silver.

I have subsequently frequently repeated this experiment on myself and others, using greater precaution, and have invariably obtained similar symptoms of urtication. In only one instance has a minute ulceration been the consequence.

It is very evident therefore that the Actiniæ act by means of an acrid irritant poison, similar in some respects to that of the wasp, or of snakes, which quickly spreads through the system of the Annelida, producing the above-mentioned results.

It remained to determine whether the poisoned weapons existing in such numbers over the surface of the Actiniæ were left in the part attacked. For this purpose I stretched a thin India-rubber membrane over a glass tube. After its seizure by the Actinia, I found that under the microscope it was studded in many points with the poison darts inserted slightly in the membrane, without their having penetrated through. In this respect my observations differ from those of Mr. Gosse, who considers that a fragment of cuticle from the hand was perforated by these darts.

May 19, 1859.—Major-General Sabine, R.A., Treas. and V.P., in the Chair.

"On the Anatomy of *Victoria Regia*." Part II. By Arthur Henfrey, Esq., F.R.S., F.L.S. &c., Professor of Botany in King's College, London.

This paper is a continuation of one published in the Philosophical Transactions for 1852 (p. 289), and discusses the general question

of the anatomical structure of the stems of Monocotyledons and Dicotyledons, especially in reference to some objections taken against the author's views respecting the stems of the Nymphæaceæ. Certain peculiarities of the structure of roots are next examined; and these are shown to be formed on the Dicotyledonous type in *Victoria.*

The germination of the seed is described in a manner differing to some extent from the accounts given by Planchon, Trécul, and Hooker. The error of Trécul, in stating that the earlier leaves are devoid of a stipule, is shown to depend upon his overlooking the true axillary position of that organ.

The Phyllotaxy is next treated, with the development and arrangement of the leaves and roots; lastly, a complete history of the development of the flower, showing that the apparently inferior position of the ovary depends upon a great enlargement of the receptacle after the formation of the various organs forming the flower.

May 26, 1859.—Sir Benjamin C. Brodie, Bart., President, in the Chair.

"On certain Sensory Organs in Insects, hitherto undescribed." By J. Braxton Hicks, M.D. Lond., F.L.S. &c.

The author commences with an allusion to papers published in the Linnean Society's 'Journal' and 'Transactions' respecting groups of organs, abundantly supplied with nerves, on the bases of the halteres of Diptera, also on the nervures of the wings and on the elytra of Coleoptera, and now gives a drawing which shows forth these organs and the nerve proceeding to them on the halteres. He then describes, for the first time, somewhat similar organs on the apices of the palpi of some Diptera, and on their base in many Hymenoptera, as *Apis, Vespa, Nomada, Megachile, Bombus,* &c. These are well shown in the *Vespa Crabro,* or Hornet, where the nerve is seen expanding in the thin membrane which covers in the opening beneath in the wall of the member.

In the paper, also, it is pointed out for the first time, that on the apex of the palpi of Lepidoptera there is invariably found a structure which is more or less of a cavity, generally tubular, and sometimes extending inwards nearly the length of the last segment, but sometimes only a depression. To it a nerve is given which expands on the apex of the cavity.

The author then describes groups of organs, allied in form to those on the palpi, which are to be found on the legs of all insects yet examined. There are about three groups situated about the trochantero-femoral joint, and to them nerves can be distinctly seen proceeding; and in *Meloë* the branch is seen to pass up the opening in the wall, to terminate in a papilla in the centre of the membrane covering it in.

It is also shown that the bladder-like apex of the palpi, instead of being smooth, as is generally described, is covered with a great number of small bodies, something in form like ninepins, some-

times exceedingly small, requiring a ⅛-inch objective to make them out, when they can clearly be discerned to be a modified condition of true hairs copiously supplied with nerves. The author names these "*tactile hairs*," and points out their existence in all palpi used for touching, and in other organs subservient to that function. These tactile hairs are very large in the palpi and antennæ of *Dyticus marginalis*. The barrel-like organs of the Lepidoptera are next investigated, and are shown to have a nerve passing up them; but whether proceeding to the apex of the nipple-like papilla on them or not, cannot be quite made out. They are pointed out as being nearly allied to the organs on each of the palpi of the Earwig (*Forficula auricularia*).

The author refers to the sacs found on the antennæ of all insects, which have been fully treated of in two papers read by him before the Linnean Society, and published in their 'Transactions;' and he lastly examines the probable functions of all these organs, which must be of sensation, probably special.

Attention is also called to the value of bleaching the tissues by chlorine in investigating the structure of insects, which process was first used by the author and described by him in the papers above mentioned.

"On the Occurrence of Flint-implements, associated with the Remains of Extinct Mammalia, in Undisturbed Beds of a late Geological Period." By Joseph Prestwich, Esq., F.R.S., F.G.S. &c.

The author commences by noticing how comparatively rare are the cases even of the alleged discovery of the remains of man or of his works in the various superficial drifts, notwithstanding the extent to which these deposits are worked; and of these few cases so many have been disproved, that man's non-existence on the earth until after the latest geological changes, and the extinction of the Mammoth, Tichorhine Rhinoceros, and other great mammals, had come to be considered almost in the light of an established fact. Instances, however, have from time to time occurred to throw some doubt on this view, as the well-known cases of the human bones found by Dr. Schmerling in a cavern near Liege,—the remains of man, instanced by M. Marcel de Serres and others in several caverns in France,—the flint-implements in Kent's Cave,—and many more. Some uncertainty, however, has always attached to cave-evidence, from the circumstance that man has often inhabited such places at a comparatively late period, and may have disturbed the original cave-deposit; or, after the period of his residence, the stalagmitic floor may have been broken up by natural causes, and the remains above and below it may have thus become mixed together, and afterwards sealed up by a second floor of stalagmite. Such instances of an imbedded broken stalagmitic floor are in fact known to occur; at the same time the author does not pretend to say that this will explain all cases of intermixture in caves, but that it lessens the value of the evidence from such sources.

The subject has, however, been latterly revived, and the evidence more carefully sifted by Dr. Falconer; and his preliminary reports on the Brixham Cave*, presented last year to the Royal Society, announcing the carefully determined occurrence of worked flints mixed indiscriminately with the bones of the extinct Cave Bear and the Rhinoceros, attracted great and general attention amongst geologists. This remarkable discovery, and a letter written to him by Dr. Falconer on the occasion of his subsequent visit to Abbeville last autumn, instigated the author to turn his attention to other ground, which, from the interest of its later geological phenomena alone, as described by M. Buteux in his "Esquisse Géologique du Departement de la Somme," he had long wished and intended to visit.

In 1849 M. Boucher de Perthes, President of the "Société d'Émulation" of Abbeville, published the first volume of a work entitled "Antiquités Celtiques et Antédiluviennes," in which he announced the important discovery of worked flints in beds of undisturbed sand and gravel containing the remains of extinct mammalia. Although treated from an antiquarian point of view, still the statement of the geological facts by this gentleman, with good sections by M. Ravin, is perfectly clear and consistent. Nevertheless, both in France and in England, his conclusions were generally considered erroneous; nor has he since obtained such verification of the phenomena as to cause so unexpected a fact to be accepted by men of science. There have, however, been some few exceptions to the general incredulity. The late Dr. Rigollot, of Amiens, urged by M. Boucher de Perthes, not only satisfied himself of the truth of the fact, but corroborated it, in 1855, by his "Mémoire sur des Instruments en Silex trouvés à St. Acheul." Some few geologists suggested further inquiry; whilst Dr. Falconer, himself convinced by M. de Perthes' explanations and specimens, warmly engaged Mr. Prestwich to examine the sections.

The author, who confesses that he undertook the inquiry full of doubt, went last Easter, first to Amiens, where he found, as described by Dr. Rigollot, the gravel-beds of St. Acheul capping a low chalk-hill a mile S.E. of the city, about 100 feet above the level of the Somme, and not commanded by any higher ground. The following is the succession of the beds in descending order:—

	Average thickness.
1. Brown brick-earth (*many old tombs and some coins*), with an irregular bed of flint-gravel. No organic remains.	10 to 15 ft.
Divisional plane between 1 *and* 2*a very uneven and indented.*	
2*a*. Whitish marl and sand with small chalk debris. Land and freshwater shells (*Lymnea*, *Succinea*, *Helix*, *Bithynia*, *Planorbis*, *Pupa*, *Pisidium*, and *Ancylus*, all of recent species) are common, and mammalian bones and teeth are occasionally found	2 to 8 ft.

* On the 4th of May, this year, Dr. Falconer further communicated to the Geological Society some similar facts, though singularly varied, recently discovered by him in the Maccagnone Cave near Palermo.—See Proc. Geol. Soc.

Average thickness.

2*b*. Coarse subangular flint-gravel,—white with irregular ochreous and ferruginous seams,—with tertiary flint pebbles and small sandstone blocks. Remains of shells as above, in patches of sand. Teeth and bones of the elephant, and of a species of horse, ox, and deer,—generally near base. This bed is further remarkable for containing worked flints ("Haches" of M. de Perthes, and "Langues de Chat" of the workmen) .... 6 to 12 ft.
Uneven surface of chalk.

The flint-implements are found in considerable numbers in 2*b*. On his first visit, the author obtained several specimens from the workmen, but he was not successful in finding any himself. On his arrival, however, at Abbeville, he received a message from M. Pinsard of Amiens, to whose cooperation he expresses himself much indebted, to inform him that one had been discovered the following day, and was left *in situ* for his inspection. On returning to the spot, this time with his friend Mr. Evans, he satisfied himself that it was truly *in situ*, 17 feet from the surface, in undisturbed ground, and he had a photographic sketch of the section taken*.

Dr. Rigollot also mentions the occurrence in the gravel of round pieces of hard chalk, pierced through with a hole, which he considers were used as beads. The author found several, and recognized in them a small fossil sponge, the *Coscinopora globularis*, D'Orb., from the chalk, but does not feel quite satisfied about their artificial dressing. Some specimens do certainly appear as though the hole had been enlarged and completed.

The only mammalian remains the author here obtained, were some specimens of the teeth of a horse—but whether recent or extinct the specimens were too imperfect to determine; and part of the tooth of an elephant (*Elephas primigenius*?). In the gravel-pit of St. Roch, 1½ mile distant, and on a lower level, mammalian remains are far more abundant, and include *Elephas primigenius*, *Rhinoceros tichorhinus*, *Cervus somonensis*, *Bos priscus*, and *Equus*†; but the workmen said that no worked flints were found there, although they are mentioned by Dr. Rigollot.

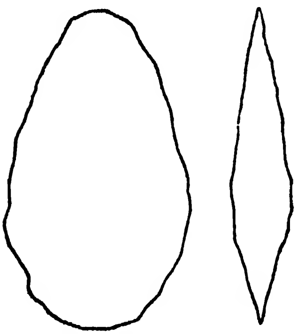
At Abbeville the author was much struck with the extent and beauty of M. Boucher de Perthes' collection. There were many forms of flints, in which he, however, failed to see traces of design or work, and which he should only consider as accidental; but with regard to those flint-instruments termed "axes" ("haches") by M. de Perthes, he entertains not the slightest doubt of their artificial make. They are of two forms, generally from 4 to 10 inches long: the outlines of two specimens are represented in the following dia-

* On revisiting the pit, since the reading of this paper, in company with several geological friends, the author was fortunate to witness the discovery and extraction by one of them, Mr. J. W. Flower, of a very perfect and fine specimen of flint-implement, in a seam of ochreous gravel, 20 feet beneath the surface. They besides obtained thirty-six specimens from the workmen.—June, 1859.

† To this list the author has to add the *Hippopotamus*, of which creature four fine tusks were obtained on this last visit.

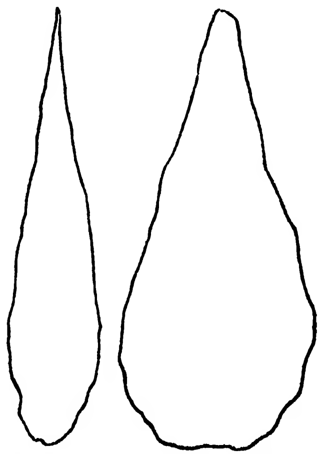
gram. They are very rudely made, without any ground surface, and were the work of a people probably unacquainted with the use of metals. These implements are much rarer at Abbeville than at Amiens, fig. 1 being the common form at the former, and fig. 2 at

Fig. 1.



Front section. Side section.

Fig. 2.



Side section. Front section.

One-third the natural size.

the latter place. The author was not fortunate enough to find any specimens himself; but from the experience of M. de Perthes, and the evidence of the workmen, as well as from the condition of the specimens themselves, he is fully satisfied of the correctness of that gentleman's opinion, that they there also occur in beds of undisturbed sand and gravel.

At Moulin Quignon, and at St. Gilles, to the S.E. of Abbeville, the deposit occurs, as at St. Acheul, on the top of a low hill, and consists of a subangular, ochreous and ferruginous flint-gravel, with a few irregular seams of sand, 12 to 15 feet thick, reposing upon an uneven surface of chalk. It contains no shells, and very few bones. M. de Perthes states that he has found fragments of the teeth of the elephant here. The worked flints and the bones occur generally in the lower part of the gravel.

In the bed of gravel also on which Abbeville stands, a number of flint-implements have been found, together with several teeth of the *Elephas primigenius*, and, at places, fragments of freshwater shells.

The section, however, of greatest interest is that at Menchecourt, a suburb to the N.W. of Abbeville. The deposit there is very distinct in its character; it occurs patched on the side of a chalk hill, which commands it to the northward; and it slopes down under

the peat-beds of the valley of the Somme to the southward. The deposit consists, in descending order, of—

	Average thickness.
1. A mass of brown sandy clay, with angular fragments of flints and chalk rubble. No organic remains. Base very irregular and indented into bed No. 2	2 to 12 ft.
2. A light-coloured sandy clay ("sable gras" of the workmen), analogous to the loess, containing land shells, *Pupa*, *Helix*, *Clausilia* of recent species. Flint-axes and mammalian remains are said to occur occasionally in this bed	8 to 25 ft.
3. White sand ("sable aigre"), with 1 to 2 feet of subangular flint-gravel at base. This bed abounds in land and freshwater shells of recent species of the genera *Helix*, *Succinea*, *Cyclas*, *Pisidium*, *Valvata*, *Bithynia*, and *Planorbis*, together with the marine *Buccinum undatum*, *Cardium edule*, *Tellina solidula*, and *Purpura lapillus*. The author has also found the *Cyrena consobrina* and *Littorina rudis*. With them are associated numerous mammalian remains, and, it is said, flint-implements................................	2 to 6 ft.
4. Light-coloured sandy marl, in places very hard, with *Helix*, *Zonites*, *Succinea*, and *Pupa*. Not traversed	3 +

The Mammalian remains enumerated by M. Buteux from this pit are *Elephas primigenius*, *Rhinoceros tichorhinus*, *Cervus somonensis?*, *Cervus tarandus priscus*, *Ursus spelæus*, *Hyæna spelæa*, *Bos primigenius*, *Equus adamaticus*, and a *Felis*. It would be essential to determine how these fossils are distributed—which occur in bed No. 2, and which in bed No. 3. This has not hitherto been done. The few marine shells occur mixed indiscriminately with the freshwater species, chiefly amongst the flints at the base of No. 3. They are very friable and somewhat scarce. It is on the top of this bed of flints that the greater number of bones are found, and also, it is said, the greater number of flint-implements. The author, however, only saw some long flint flakes (considered by M. de Perthes as flint knives) turned out of this bed in his presence; but the workmanship was not very clear or apparent; still it was as much so as in some of the so-called flint knives from the peat-beds and barrows. There are specimens, however, of true implements ("haches") in M. de Perthes' collection from Menchecourt; one noticed by the author was from a depth of 5, and another of 7 metres. This would take them out from bed No. 1, but would leave it uncertain whether they came from No. 2 or No. 3. From their general appearance, and traces of the matrix, the author would be disposed to place them in bed No. 2, but M. de Perthes believes them to be from No. 3; if so, it must have been in some of the subordinate clay seams occasionally intercalated in the white sand.

Besides the concurrent testimony of all the workmen at the different pits, which the author after careful examination saw no reason to doubt, the flint-implements ("haches") bear upon themselves internal evidence of the truth of M. de Perthes' opinion. It is a peculiarity of fractured chalk flints to become deeply and permanently stained and coloured, or to be left unchanged, according to the nature of the matrix in which they are imbedded. In most clay

beds they become outside of a bright opaque white or porcelainic; in white calcareous or siliceous sand their fractured black surfaces remain almost unchanged; whilst in beds of ochreous and ferruginous sands, the flints are stained of the light yellow and deep brown colours so well exhibited in the common ochreous gravel of the neighbourhood of London. This change is the work of very long time, and of moisture before the opening out of the beds. Now in looking over the large series of flint-implements in M. de Perthes' collection, it cannot fail to strike the most casual observer that those from Menchecourt are almost always white and bright, whilst those from Moulin Quignon have a dull yellow and brown surface; and it may be noticed that whenever (as is often the case) any of the matrix adheres to the flint, it is invariably of the same nature, texture, and colour as that of the respective beds themselves. In the same way at St. Acheul, where there are beds of white and others of ochreous gravel, the flint-implements exhibit corresponding variations in colour and adhering matrix; added to which, as the white gravel contains chalk debris, there are portions of the gravel in which the flints are more or less coated with a film of deposited carbonate of lime; and so it is with the flint-implements which occur in those portions of the gravel. Further, the surface of many specimens is covered with fine dendritic markings. Some few implements also show, like the fractured flints, traces of wear, their sharp edges being blunted. In fact, the flint-implements form just as much a constituent part of the gravel itself—exhibiting the action of the same later influences and in the same force and degree—as the rough mass of flint fragments with which they are associated.

With regard to the geological age of these beds, the author refers them to those usually designated as post-pliocene, and notices their agreement with many beds of that age in England. The Menchecourt deposit much resembles that of Fisherton near Salisbury; the gravel of St. Acheul is like some on the Sussex coast; and that of Moulin Quignon resembles the gravel at East Croydon, Wandsworth Common, and many places near London. The author even sees reason, from the general physical phenomena, to question whether the beds of St. Acheul and Moulin Quignon may not possibly be of an age one stage older than those of Menchecourt and St. Roch; but before that point can be determined, a more extended knowledge of all the organic remains of the several deposits is indispensable.

The author next proceeds to inquire into the causes which led to the rejection of this and the cases before mentioned, and shows that in the case of M. de Perthes' discovery, it was in a great degree the small size and indifferent execution of the figures and the introduction of many forms about which there might reasonably be a difference of opinion;—in the case of the arrow-heads in Kent's Cave a hidden error was merely suspected;—and in the case of the Liege cavern he considers that the question was discussed on a false issue. He therefore is of opinion that these and many similar cases require reconsideration; and that not only may some of these prove true, but that many others, kept back by doubt or supposed error, will be forthcoming.

One very remarkable instance has already been brought under the author's notice by Mr. Evans since their return from France. In the 13th volume of the 'Archæologia,' published in 1800, is a paper by Mr. John Frere, F.R.S. and F.S.A., entitled "An Account of Flint-Weapons discovered at Hoxne in Suffolk," wherein that gentleman gives a section of a brick-pit in which numerous flint-implements had been found, at a depth of 11 feet, in a bed of gravel containing bones of some unknown animal; and concludes from the ground being undisturbed and above the valley, that the specimens must be of very great antiquity, and anterior to the last changes of the surface of the country,—a very remarkable announcement, hitherto overlooked.

The author at once proceeded in search of this interesting locality, and found a section now exposed to consist of—

	feet.
1. Earth and a few flints	2
2. Brown brick-earth, a carbonaceous seam in middle and one of gravel at base; no organic remains. The workmen stated that two flint-implements (one of which they shortly picked up in the author's presence) had been found about 10 feet from the surface during the last winter	12
3. Grey clay, in places carbonaceous and in others sandy, with recent land and freshwater shells (*Planorbis*, *Valvata*, *Succinea*, *Pisidium*, *Helix*, and *Cyclas*) and bones of Mammalia	4
4. Small subangular flint-gravel and chalk pebbles	2½
5. Carbonaceous clay (stopped by water)	½+

The weapons referred to by Mr. Frere are described by him as being found abundantly in bed No. 4; but at the spot where the work has now arrived, this bed is much thinner, and is not worked. In the small trench which the author caused to be dug, he found no remains either of weapons or of bones. He saw, however, in the collection of Mr. T. E. Amyot, of Diss, specimens of the weapons, also an astragalus of the elephant from, it was supposed, this bed, and, from bed No. 3, the teeth of a horse, closely resembling those from the elephant-bed of Brighton.

The specimens of the weapons figured by Mr. Frere, and those now in the British Museum and elsewhere, present a singular similarity in work and shape to the more pointed forms from St. Acheul.

One very important fact connected with this section, is that it shows the relative age of the bone and implement-bearing beds. They form a thin lacustrine deposit, which seems to be superimposed on the Boulder Clay, and to pass under a bed of the ochreous sand and flint-gravel belonging to the great and latest drift-beds of the district.

The author purposely abstains for the present from all theoretical considerations, confining himself to the corroboration of the facts:—

1. That the flint-implements are the work of man.
2. That they were found in undisturbed ground.
3. That they are associated with the remains of extinct Mammalia.
4. That the period was a late geological one, and anterior to the surface assuming its present outline, so far as some of its minor features are concerned.

He does not, however, consider that the facts, as they at present stand, of necessity carry back Man in past time more than they bring forward the great extinct Mammals towards our own time, the evidence having reference only to relative and not to absolute time; and he is of opinion that many of the later geological changes may have been sudden or of shorter duration than generally considered. In fact, from the evidence here exhibited, and from all that he knows regarding drift phenomena generally, the author sees no reason against the conclusion that this period of Man and the extinct Mammals—supposing their contemporaneity to be proved—was brought to a sudden end by a temporary inundation of the land; on the contrary, he sees much to support such a view on purely geological considerations.

The paper concludes with a letter from Mr. John Evans, F.S.A. and F.G.S., regarding these implements from an antiquarian rather than a geological point of view, and dividing them into three classes:—

1. Flint flakes—arrow-heads or knives.
2. Pointed weapons truncated at one end, and probably lance or spear heads (fig. 2).
3. Oval or almond-shaped implements with a cutting edge all round, possibly used as sling-stones or as axes (fig. 1).

Mr. Evans points out that in form and workmanship those of the two last classes differed essentially from the implements of the so-called Celtic period, which are usually more or less ground and polished, and cut at the wide and not the narrow end; and that, had they been found under any circumstances, they must have been regarded as the work of some other race than the Celts or known aboriginal tribes. He fully concurs with Mr. Prestwich, that the beds of drift in which they were found were entirely undisturbed.

MISCELLANEOUS.

Note on the Affinities of Rhynchosaurus. By Prof. Richard Owen, F.R.S.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—A second and better-preserved specimen of the rare fossil reptile, *Rhynchosaurus*, from the New Red Sandstone of Shropshire, having been lately obtained from the Grinsill quarries, near Shrewsbury, and kindly transmitted for my examination by the authorities of the Museum of Natural History of that town, I have been enabled to determine the position of the two nostrils a little in front of the orbits, and to discern traces of dental structure in parts of the two bodies which, in the original specimen described by me in 1842, held the place of, and were described as, "intermaxillary bones." This discovery adds to the reasons for associating the *Rhynchosaurus* with the *Dicynodon*, in the same natural order or group

of reptiles, and confirms the opinion expressed in my first memoir on *Dicynodon*, as to the "close and important relationship between *Dicynodon* and *Rhynchosaurus* *." It similarly strengthens the opinion that the formations in South Africa containing remains of *Dicynodon* belong to the same geological system (the Triassic) as the Sandstones at Grinsill, Shropshire.

In the species of Dicynodonts already described may be seen a progressive advance in the position of the pair of descending tusks of the upper jaw, from below the orbits (as in *D. strigiceps*) to below the nostrils (as in *Ptychognathus declivis*); but in *Rhynchosaurus* the bodies which are analogous, if not homologous, take the place of the premaxillary bones, and terminate the anterior contour of the skull, curving down in the present as in the first-described specimen, in front of the symphysis mandibulæ, and presenting an exaggerated condition of that pair of compound osseous and dentinal bodies which hold the place of the premaxillaries in the rare existing New Zealand amphicœlian lizard, *Rhynchocephalus* †.

There is no trace of the deflected tusk-like bodies, in *Rhynchosaurus*, being implanted in bone.

I am, Gentlemen,
Yours truly,
RICHARD OWEN.

British Museum, Aug. 24, 1859.

Note on Bulimus acutus. By Dr. J. E. GRAY, F.R.S. &c.

Bulimus acutus has been generally supposed to be confined, in the British Islands, to the West of England and Wales: it is found in abundance on the low lands on the east side of the Chesil Bank, between Weymouth and Portland, and also on the hills on the west of Lulworth Cove. It seems to appear, in the latter place at least, periodically. It is now extremely abundant, both on the grass and congregated together at the roots of the sea-beet, near the coast-guard signal station; but the coast-guardsman, who has been on the station several years, said he had not seen it before this year, and he believed that they had been blown from the opposite hills! perhaps he only meant to say, in such abundance. Now it is even more common than *Helix virgata*, with which it is found.

Swanage, August 1859.

Note on the Opercula of several Species of Megalomastoma. By W. H. BENSON, Esq.

The structure of the horny operculum of *Megalomastoma cylindraceum*, Ch., approaches, at its dorsal side, to that of *Hybocystis*, differing from the numerous spiral volutions visible on that part of the thin horny operculum of the Himalayan *M. funiculatum*, and

* Trans. Geol. Soc., 2nd ser. vol. vii. p. 67 (1845).
† *Ibid.*, vol. vii. pl. 6. fig. 519.

from the concentric moulding observable in the thickened corneous operculum of the West Indian *M. Mani*, Poey.

A redistribution of the species of *Megalomastoma*, grounded on the construction of the operculum, is desirable.

The specimens above referred to occur in my own collection. It is probable that few cabinets besides that of Mr. H. Cuming possess the materials requisite for the work.

August 11, 1859.

On two new species of American Ant-Thrushes.
By P. L. Sclater, F.R.S.

1. Myrmelastes plumbeus.

♂. *Nigricanti-plumbeus, alis caudaque obscure nigris; tectricum alarium apicibus albo guttatis; rostro et pedibus nigris.*

♀. *Mari similis, sed corpore toto subtus ferrugineo-rufo.*

Long. tota 6·0, alæ 3·1, caudæ 2·3, rostri a rictu 1·05, tarsi 1·2.

Hab. Upper Amazon, Rio Javarri (*Bates*).

Mus. Brit., P. L. S.

The British Museum possesses both sexes of this fine, strong Ant-thrush from collections lately transmitted by Mr. Bates from Ega, but originating, I believe, from further up the stream. I have a single male specimen from the same source. The female has so nearly the same general appearance as *Thamnophilus hyperythrus* ♂, that they might easily be confounded at first sight.

2. Myrmelastes nigerrimus.

Unicolor nigerrimus, tectricibus alarum superioribus, campterio proximis, albis.

Long. tota 6·5, alæ 3·3, caudæ 2·3, tarsi 1·3.

Hab. Upper Amazon (*Bates*).

Mus. Brit.

A single example of this bird occurred in the same collection as the former species, and is now in the British Museum. It is quite the same form as *Myrmelastes plumbeus*, with the exception of the bill being slightly shorter and the feet rather stronger. It is marked "Irides black, bill black." It is without doubt a male; and it will be interesting to see the female.—*Proc. Zool. Soc.* May 11, 1858.

On the Habits of Aplysiopterus viridis.
By Dr. J. E. Gray, F.R.S. &c.

This animal is not uncommon at this season (August) in Swanage Bay. It is very peculiar in not having any distinctly marked foot, except just a little in front of the narrow acute tip of the tail. When walking on the surface of the vase in which it is contained, it only touches the glass by this end of the tail and the front of the body under the head and tentacles, the rest of the under surface of the body being quite free, at some distance from the glass, and rounded,

without any appearance of a ventral sole. Its favourite position is floating rather below the surface of the water, back downwards and with the edges of the mantle expanded nearly horizontally, and attached to the glass by the under surface of the tip of its tail, or to the side of the vase with its head towards the surface of the water. If the vase is moved or otherwise shaken, the animal contracts its mantle over the back, and descends head foremost, as it were dropping down to the bottom, leaving a mucous filament attached to the glass; and it ascends by this filament, apparently eating it as its head rises towards the surface, and at length becomes attached as before by its subcaudal sole.

The dark-green colour is produced by minute internal granules which vary in the intensity and in the shade of their colour, some being dark olive and others reddish brown. The margin of the mantle is white in all the specimens I have seen.

Description of a new Species of Tænia. By W. Baird, M.D., F.L.S.

Tænia sulciceps.

Caput tetragonum, magnum, acetabulis anticis lateralibus, orbicularibus, longe segregatis, sulco interposito. Proboscis nulla. Os terminale inerme. Collum longum, læve. Articuli supremi breviores; deinde longiores, infundibuliformes, angusti; lateribus undulatis, crenatis. Aperturæ genitales marginales, unilaterales.

Hab. In intestinis *Diomedeæ exulantis.*

Longitudo exemplorum in possessione nostra, quæ sunt fragmenta solum, unciæ tredecim.

In Museo Britannico.

The colour of this Tape-worm is a straw-yellow. The head is tetragonal in shape, large; and the neck is long, measuring nearly two or three lines, and quite smooth. Upon minute inspection, I could discover no trace of a proboscis; and the mouth was destitute of hooks of any kind. The joints of the body are small at first, becoming larger as they descend; but even when full-grown are narrow, somewhat undulated on the margin, and slightly but irregularly crenated. The suckers on the head are of considerable size, round in shape, and are separated from each other by a rather deep furrow. The genital orifices are situated on the lower margin of each joint, and are all on the same side. None of the specimens are quite perfect; but there are two or three fragments, each about 13 inches in length.

This Tapeworm was taken by Mr. Edward Gerrard of the British Museum, from the intestines of the Albatros (*Diomedea exulans*), and is now in the collection of Entozoa in the British Museum.—*Proc. Zool. Soc.* Feb. 22, 1859.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 22. OCTOBER 1859.

XXV.—*On the supposed Existence of Cellulose in Starch-grains.* By H. von Mohl *.

On no vegetable structure has so great a number of micro-chemical researches been instituted as upon starch-grains; and of none have the structure and chemical composition, in the course of time, been so contradictorily explained. The view of Raspail, that the starch-grain consisted of a vesicular envelope insoluble in water, with soluble gummy contents, was overturned by the researches of Fritzsche and of Payen, who appeared to have demonstrated beyond all doubt that the starch-grain consisted of superimposed layers, formed of one and the same chemical compound throughout the whole thickness of the grain; but Nägeli believed, in his earlier researches at least, that he could discern an outer cellulose membrane,—which opinion was again questioned by myself. Muschke (Journ. f. Prakt. Chemie, lvi. p. 400) still more strongly asserted the presence of cellulose in the starch-grain, thinking he had found the latter to consist of a number of concentric membranes formed of cellulose, between which the starch-substance was deposited, and this in a double modification—one soluble in water, which formed the bright layers of the starch-grain, and one insoluble, of which the dark layers were composed. All these accounts, however, may now be regarded as out of date, since the recent researches of Nägeli ('Die Stärkekörner,' Monographie, 1858) prove indubitably that the whole starch-granule, in all its parts, is composed of two distinct chemical compounds, which in his view form a kind of diffusion †. He arrived at this conclusion

* Bot. Zeitung, July 1st & 8th, 1859; translated by A. Henfrey, F.R.S.

† A very long account of the structure and development of starch has just been published by Trécul in the 'Ann. des Sc. nat.' sér. 4. t. x. It does not contain any new matter of great importance: he advocates the view

by macerating the starch-grains, at a moderate heat (about 104° to 120° F.) in solvent fluids, particularly in *saliva*, which extracted the compound which becomes blue with iodine (the proper starch,) and leaves behind the starch-grains essentially unaltered in their anatomical conditions, but with totally different chemical properties. For the compound dissolved out of the starch he proposes the term *granulose* (p. 209); the remaining substance of the grains is described as cellulose*.

As my critical repetition of Nägeli's observations leads me to regard this last opinion as unfounded, I venture to publish an account of my investigations.

In making the inquiry, I chiefly employed as material the starch of the rhizome of *Canna indica*. For the extraction of the substance coloured blue by iodine I used saliva, because this acts more quickly than extract of malt. The attempt to obtain the same result by organic acids, in the manner described (certainly in no great detail) by Melsens, was unsuccessful. It is necessary to discover by experiment, for each kind of starch, the favourable temperature at which it is to be treated; for at too low a temperature the action does not take place at all, or only very slowly, while too high a temperature produces swelling up and total solution of the granule. In consequence of the latter circumstance, I was less regardful of the maintenance of a constant temperature in the hatching-machine in which I heated the grains than that a certain definite degree of heat should not be exceeded. In the starch of *Canna*, the extraction of the starch-substance began at a temperature of 95°–104°F., and advanced very slowly and regularly from the periphery of the granule towards its centre, unless it could penetrate by an accidental crack in the granule, in which case the solution in the interior of the granule proceeded rapidly onward from the sides of the crack. At a temperature of 120°–131° the extraction of the soluble part of the granule was completed in a few hours. A far lower temperature suffices for the extraction of the starch of wheat, while that of potatoes requires a much higher one. If the operation is carried on at a low temperature, the experiment lasting then several days, we must not neglect to pour off

that the layers are formed from without inwards, the older expanding to make room for the new ones.—A. H.

* As often happens, the same discovery of the composition of the starch-grain was made, apparently independently of Nägeli, by Melsens (Institut, 1857, p. 161), who extracted the substance coloured blue by iodine by means of organic acids, diastase, and pepsine, and conjectured that the residue consisted of a nitrogenous substance and another standing near to cellulose. I am unaware whether he has made known his researches in greater detail than in the work here cited.

the saliva daily from the starch-grains, and wash them well, and mix them with fresh saliva, since the putrefactive decomposition of the latter would otherwise ensue, which produces destruction of the starch-grains.

The alterations undergone by the starch-grains are described so accurately by Nägeli that a repetition of the account is entirely superfluous; I confine myself, therefore, to citing the most general features, and to the discussion of those points which appear to me of especial importance for the explanation of the composition of the starch-grain.

The first glance at the starch-grain robbed of its soluble constituent by saliva shows that it has lost considerably in substance, since it possesses far less refractive power; and its much greater mobility in water, and the longer time it takes to settle when stirred up therein, show that it has lost considerably in weight. I could not determine how great this loss of weight is, since this would require a different solvent, which could be removed from the starch-grains entirely by washing, while in the use of saliva many epithelial cells of the lining membrane of the mouth remain mixed up with the granules. The estimate of Nägeli (p. 183), that in potato-starch the mass diminishes from 7 or 8 to 1, may be correct, but it rests upon too insecure a base to be depended upon with certainty.

The magnitude of the grains diminishes far less than the substance; but the amount of decrease is very difficult to state with certainty, on account of the very variable absolute size of the individual grains; and a great number of measurements would be requisite to obtain an approximation to an accurate determination. That a diminution of size does take place, may be very distinctly seen in the starch-grains of germinating wheat, in which the extraction of the soluble substance frequently proceeds, not uniformly from the margin to the centre of the discoid grains, but in separate lines running in the direction of radii, under which circumstance each of these streaks corresponds to a notch or depression at the margin of the grain, which indicates a collapse of the substance towards the interior. Not only, however, is there a contraction of the substance in the radial direction, but there is a still stronger contraction in the direction of the separate laminæ. This is shown very clearly by the behaviour of those grains of *Canna* in which the solution has affected only the outermost layers, when these latter laminæ frequently crack into polyhedral fragments, like dried clay, because the inner and still unaltered laminæ oppose an insurmountable obstacle to their efforts to contract. A still stronger contraction occurs in the laminæ situated between the periphery and the organic centre (likewise in the direction of the laminæ),

as is evident from the circumstance that all the grains of *Canna* from which the soluble substance is entirely removed are traversed by cracks, some tolerably wide, which run out like rays from the centre to the periphery, and are wider in the middle than in the centre and at the periphery, towards which latter they generally thin off;—but when they reach the surface, they frequently cause the grains to fall into sharp-cornered triangular fragments. As these cracks are not connected with the formation of a cavity in the centre of the grain, they do not originate by the inner laminæ becoming contracted in the radial direction with a simultaneous drawing outwards towards the firmer outer layers, causing a lateral extension until they are torn across, but the cracks evidently arise from the contraction of the laminæ of the grains being stronger in the direction of the tangent than in the radial direction.

The lamination undergoes no change by the treatment with saliva. In many cases, particularly when a slow solution of the soluble substance of the grain takes place in the living plant (for example, in germinating wheat), the lamination becomes much more evident in the earlier stages of the process than it was previously, as the solution does not affect all the layers uniformly, but at the outset shows itself only in the looser laminæ, and thereby considerably increases the already existing difference of density of alternating laminæ. But when the soluble portion has been entirely extracted from all the laminæ, and the whole grain has thus acquired far greater transparency, the lamination is mostly far more difficult to perceive than in the fresh grain, as may be seen particularly in the very distinctly laminated grains of the potato.

The substance of the grains which have been exhausted by saliva, so long as they are saturated with water, is in a high degree brittle, and a slight pressure on the covering-glass causes it to crumble into sharp-cornered fragments. When dried, it contracts considerably, which renders the lamination much more indistinct; and a re-wetting with water does not always restore it in the original clearness.

Grains with the starch extracted act upon polarized light exactly like unaltered starch-grains; *i. e.*, when the direction of their laminæ is observed, in the opposite manner to cellulose membranes. In a former paper in this Journal*, on the investigation of vegetable tissues by the aid of polarized light, I regarded this diverse action as the result of a chemical constitution of the starch-grain differing from that of cellulose. The idea might certainly have been entertained that it depended upon conditions of tension in the separate layers of the starch-

* Annals, 3rd series, vol. i. pp. 198, 263.

grain: in this case it would be necessary to assume that there existed in the starch-grain, as in a glass globe whose temperature diminishes from the periphery to the centre, a dilating tension in the radial direction, and a compressing tension in the direction of the surfaces of the concentric laminæ. It might be urged in favour of this, that distinct reasons for the adoption of this view exist in the behaviour of unaltered starch-granules when dried or caused to swell up (as Nägeli thinks it probable, and I believe justly, that in the fresh granules molecules of water contained in them are interposed in greater number in the tangential than the radial molecules of the substance); but we cannot, at all events, conceive such a kind of tension to exist in those granules in which the starch-substance has been extracted from the outer laminæ by saliva, and in which, as above-mentioned, these outer laminæ become torn, by cracks which run in a radial direction, into polygonal fragments, since they cannot contract over the still unexpanded inner laminæ. Here it is beyond doubt that there exists in these outer laminæ an expansive tension in a tangential direction, which rises to the point of fracturing the laminæ, while there is a compressing tension in the radial direction, consequently the reverse of the above assumption. In spite of this, these laminæ freed from starch act in the same manner as unaltered starch-grains. Indeed the optical characters of the grains are not changed by the production of any mechanical alteration in the starch-grains—or by causing, through the action of alcohol or strong desiccation, the formation of a central cavity and the retraction of the internal layers towards the former periphery, combined with tearing in a radial direction—or by causing a swelling up, by which the outer layers then expand, especially in the direction parallel to their surfaces. It therefore appears as though we had here an example of those cases in which the optical phænomena of a body depend, not upon the density and relative distribution of its substance, but upon the quality of the material, like the conditions found by Greilich (Krystallogr. Opt. Untersuch. 1858, p. 226) in the comparison of isomorphous compounds of potash and ammonia. In such cases we could not doubt that the optical behaviour of the bodies depended on their intimate molecular conditions. We must, doubtless, recognize this molecular diversity—such as occurs, for example, in the various kinds of sugar—in reference to its effects upon polarized light, first of all as a physical property belonging to them; but, since we have no means of acquiring information regarding the peculiarities of the molecules, and since these peculiarities run parallel with the chemical composition of bodies, I believe I am perfectly justified in assuming that the contrast of negative and positive colours

exhibited by vegetable structures in polarized light stands in connexion with the chemical composition of these structures.

Turning from the consideration of the physical qualities of the starch-grains treated with saliva, to their chemical characters, and looking in the first place to their behaviour with water, we find that they are wholly deprived of the property of swelling up strongly and becoming partially dissolved. It must be premised here, that they are totally destitute of the power of swelling up strongly in water after having been crushed. This is a property of unaltered starch-grains which I think is very little known*. If dried starch-grains, of the potato, for example, are placed on a glass plate, and strongly compressed with a piece of glass of suitable form, so that each grain assumes the form of a flat disk traversed by cracks, and cold water is then added, the flattened grains in the first moment apparently contract, because they first of all swell up again into roundish grains; but they then begin to expand rapidly, as in hot water—less regularly, however, than when they are boiled, often forming pear-shaped curves, evidently because the crushing pressure acts irregularly, and affects one part of the grain more strongly than another. This is particularly evident when a grain has been exposed to strong pressure only on one side, as in this case the crushed part is pushed out in the form of a large, apparently vesicular protuberance, while the remaining part is almost unaffected†. From grains crushed in this way, cold water extracts in solution a portion of the starch-substance, which is coloured blue by iodine, as is seen when solution of iodine is added; for the iodine precipitates the dissolved substance in the form of blue gelatinous pellicles.

The starch-grains treated with saliva are equally destitute of the property of swelling up perceptibly when boiled in water. Their lamination remains as distinct as before, and the angles of cracked grains retain all their sharpness.

If starch-grains, totally deprived of their soluble substance at a tolerably high temperature, are, after thorough cleansing by washing in water, placed in a new portion of saliva, they are found altogether insoluble in it, even when the temperature is

* This swelling-up of crushed grains in cold water appears to have been noticed for the first time by myself, and is mentioned in the article "Starch" in the 'Micrographic Dictionary,' in opposition to the ordinary statement that starch is unaffected by cold water.—A. H.

† This has been explained by myself as a result of the cracks in the resisting outer laminæ allowing access of the water to the more soluble inner substance of the grain. A similar local bulging takes place when weak acid or potash is allowed to run in upon the slide and attack one side of an uncrushed grain.—A. H.

raised to 158° F., at which point unaltered starch-grains are very quickly entirely dissolved.

It is therefore evident that a strong expansive quality exists only in the starch-substance which can be extracted by saliva, and that the intimate combination in which the two substances composing the grains stand in the grains must have a modifying effect upon their respective properties. While the starch-substance is in the fresh grain protected by the substance insoluble in saliva from the solvent action of cold water, when it swells up from the action of hot water, &c., it carries the latter with it in its expansion, and transfers the solution to which it is subject by the action of saliva at a proper temperature, to the substance which in a pure condition is altogether unaffected by saliva.

The substance insoluble in saliva is regarded by Nägeli, as above mentioned, as *cellulose*. In investigating the grounds on which he makes this determination, we must first of all consider the characters which Nägeli uses for distinguishing *cellulose* and *starch*. He says (pp. 182, 189): *The reaction with iodine forms an essential distinction, and at the same time the only discriminative test, between starch and cellulose.* Iodine colours starch, when acting weakly, wine-red or violet; more strongly, indigo-blue or black: pure cellulose, on the contrary, is coloured from pale and dirty reddish to copper-red or reddish brown. Cellulose is, on the other hand, also coloured blue when softened by sulphuric acid, and likewise when saturated with tincture of iodine, dried, and afterwards wetted with water. Since the cellulose is here softened as by sulphuric acid, perhaps iodic or hydriodic acid (or both) may be formed; Nägeli thinks the formation of iodic acid probable. The action of sulphuric acid and the drying up with iodine so transform the condition of aggregation of cellulose, that it behaves like starch with iodine, or, as Nägeli thinks, is converted into starch.

This interpretation of facts, which in themselves are certainly true, is, in my opinion, altogether incorrect. Whether iodine produces a red colour (rising from wine-red, through beautiful purple, to deep violet), or a blue colour (from the brightest sky-blue to deep indigo and apparent black), depends neither on the circumstance that the object is starch or cellulose, nor upon the quantity of iodine, but essentially upon the conditions of the organic substance in respect to water. When very little water is taken up, we have a red, when more, a blue colour. By attending to this point, we may colour cellulose the finest blue, and starch red and violet, without any chemical alteration of the object.

It is self-evident that a greater or less swelling-up of the

organic substance is connected with the absorption of water; and hence one might be led to find in the capacity of expansion itself a reason for the blue colouring. But this conclusion would certainly not be justified; for we frequently find that the capability of becoming coloured with iodine does not increase in the same proportion as the capacity for swelling in water, and that, on the contrary, many parts of plants, composed of hydrate of carbon, swelling up strongly in water, are totally destitute of the power of assuming a colour with iodine. On the other hand, a certain degree of absorption of water and expansion is a necessary condition for the absorption of iodine and coloration by it, both with starch and with cellulose, as is simply proved by the circumstance that they remain uncoloured when treated in a dry condition with tincture of iodine prepared with absolute alcohol. Now a substance like starch, when placed, in its natural condition, in contact with water, absorbs such a quantity as allows it to assume a determinate colour with iodine, while another substance must be brought to absorb this water by the simultaneous action of another means, which absorption of water becomes visible to the eye, first of all by enlargement of the volume of the substance, and, with simultaneous action of iodine, by the colour which the latter produces. We are not justified in drawing at once from such an exaltation of the expansive property, and the simultaneously arising alteration of colour by iodine, the conclusion that they depend upon essential chemical changes in the substance, until it has been proved that the other properties of the substance have been altered. This is unproved, more particularly as regards cellulose which has been saturated with tincture of iodine, dried, and re-softened in water; neither is it proved of cellulose which has been made to swell up in the ammoniacal solution of copper; on the contrary, this may be perfectly dissolved in the said fluid, and precipitated in an amorphous condition from the solution, retaining all its chemical properties. We see then, on the one hand, that cellulose, without alteration of any chemical properties, absorbs more water under the influence of a material which causes it to swell up than it does in a natural condition, the power of absorbing iodine being simultaneously increased, so that it exhibits the same blue colour which the far more hygroscopic starch exhibits in its natural condition when treated with solution of iodine; further, starch, on the other hand, when placed in circumstances where it cannot become perfectly saturated with water, exhibits the same colour as cellulose only slightly expanded in water. These circumstances undoubtedly furnish proof that the blue or the red colour is not dependent upon chemical diversity of cellulose and starch, but that particular hydrated conditions of both com-

bine and become coloured in the same way with iodine. The coloration stands altogether on the boundaries between physical and chemical phænomena, and must indeed be connected in the first place with the capacity possessed by various cell-membranes which swell up rather strongly in water, to attract the colouring matter from a solution of carmine in ammonia.

As long as no other means was known by which cellulose could be coloured blue with iodine, except the simultaneous action of sulphuric acid, the conjecture was certainly not far-fetched that this acid transformed the cellulose into starch. Hence this view was many times put forth, for instance by Mitscherlich: I have always regarded it as erroneous, because the cellulose swollen up by means of sulphuric acid has none of the other characters of starch. This assumption is now positively refuted by the researches of Béchamp, who has shown that the subsequent products of the conversion of cellulose by sulphuric acid are essentially different from the corresponding transformation of products of starch, which could not be the case if sulphuric acid converted cellulose in the first place into starch.

Long before this was known, the belief in the conversion of cellulose into starch by sulphuric acid, founded on the blue coloration with iodine, must have been shaken by my demonstrating that the action of sulphuric acid was by no means necessary for the blue coloration of cellulose, but that it sufficed to saturate the cellulose with iodine (which in its usual condition it does not readily absorb) before applying water to it; then, if the cellulose is made to absorb water, the iodine renders it blue, until itself is completely extracted again by the water surrounding the preparation. Nägeli endeavours to explain this process also by a chemical conversion of the cellulose; for he conjectures that the iodine gives origin to iodic and hydriodic acids, which transform the cellulose. This is an entirely arbitrary and groundless hypothesis. It should at least have been demonstrated by experiment that these acids have the power of acting in the same manner upon cellulose as sulphuric acid, and of producing a blue colour in it in the presence of iodine. I have made the experiment of saturating purified cellulose with tincture of iodine, and adding the said acids; they caused neither a visible action upon the cellulose nor a trace of blue coloration.

But, without this demonstration that the said acids do not bring about a conversion of the cellulose and its blue coloration, it may be recognized from the behaviour of the cellulose saturated with iodine, that it is not transformed into starch. Iodine affects starch infinitely more readily than it does cellulose, so that starch absorbs the iodine out of water when only a minimum

of iodine is contained in the latter. At the same time the iodine adheres very firmly to starch, so that repeated washings with much water are required to extract the iodine from blued starch. It is quite different with cellulose saturated with iodine: it certainly also very quickly becomes blue when water is added, for it already contains the iodine; but it retains the latter with very little power, and quickly parts with it to the surrounding water. The cellulose bleached in this way is just as difficult to colour blue with iodine a second time, and takes up as little from an aqueous solution as cellulose which has never been in contact with iodine. If the saturation with iodine had caused the conversion of even a small portion of it into starch, the behaviour must have been essentially different.

The same conclusion, that the blue colouring of cellulose does not depend upon the previous formation of starch, may be drawn from the phænomena which are exhibited by cellulose under the action of chloride of zinc and iodine. I used for these experiments, on the one hand, tissues which had been purified by the known method of Schulze, by boiling with a mixture of nitric acid and chlorate of potash,—on the other hand, cellulose in an amorphous condition, which had been prepared by my colleague Schlossberger by precipitating a solution of cotton in ammoniacal solution of copper by adding common salt. The reaction of both modifications with iodine was perfectly identical. The cellulose, brought in a dry condition into contact with the viscid solution of chloride of zinc, absorbed from it so little water that it did not perceptibly swell up with it*. At the same time there was no trace of blue colouring. The colour is always some tint of red in wood-cells and vessels, in cellulose precipitated from ammoniated oxide of copper more purple or brown-red, approaching more to violet in parenchymatous cells. If the preparation saturated with iodine is now placed in water, the colour turns suddenly to blue, and very often, especially in the precipitated cellulose, to the finest indigo-blue. Yet the iodine is not firmly retained under these circumstances, but is washed out by water just as rapidly as out of cellulose with which the iodine has been incorporated by saturating with the tincture. If the chloride of zinc had caused a chemical

* This will be seen most clearly from the following experiments. It is well known that the leaves of many mosses roll up when dried, and spread out again when they absorb water. I laid stems of *Bartramia pomiformis* thus dried in the solution of chloride of zinc; but at the end of three days their leaves were as strongly rolled up as at first, although they had become somewhat more transparent; the membrane of their cells had therefore absorbed a smaller quantity of water than it contained in the natural condition of the fresh plant. When I transferred the plants from the solution of chloride of zinc into water, their leaves unfolded immediately.

conversion of the cellulose, and this had led to the production of the blue colour, it must have been rendered evident by drying this cellulose, which had been saturated with water and coloured blue, and driving off the iodine by gentle heating. If the cellulose had been converted into starch, this could not be removed from the preparation by drying, and the blue colour would necessarily make its appearance on the wetting with tincture of iodine. But this does not take place; for the cellulose behaves exactly as before—is coloured red with chloride of zinc, &c. Moreover, if cotton is treated with the ammoniated oxide of copper, yet not exposed to its action long enough to produce solution, but only until the filaments have become swollen up, the latter are coloured blue by tincture of iodine after having been well washed out with water. Under this influence of the ammoniacal solution of oxide of copper, the cellulose has acquired the property of absorbing more water than it can in its natural condition; but that we cannot imagine any conversion into starch in this case, follows from the previously mentioned circumstance, that the cellulose does not undergo this change even after complete solution, but may be precipitated with all its properties by salt.

Summing up what has been stated, it becomes evident that the blue coloration of cellulose by iodine by no means furnishes proof that the former is wholly or partly converted into starch, but that its blue colour depends solely upon the circumstance that cellulose absorbs simultaneously iodine and a sufficient quantity of water, while, with a smaller absorption of water, the red tints are produced.

Just as we are able to impart a pure blue colour to cellulose saturated with iodine by merely adding water, we can, on the other hand, by suitable operations, impart to the starch-grains the property of becoming coloured red, and not blue, with iodine. And in this case the red or blue colour depends, not upon the quantity of iodine which we incorporate with the starch, but upon the water contained in the latter.

If we place potato-starch in water, in which it is well known to become rapidly saturated, its grains begin to assume colour with the addition of a minimum of iodine; but if little iodine is applied, so that only part of the grains are coloured, and these very slightly, no red colour is produced, but the colour, if not bright, is still decidedly blue. Very different results ensue from adding an excess of iodine to the starch, allowing at the same time only slight absorption of water. If, for example, we place dry potato-starch in a solution of cane-sugar concentrated to the crystallizing point (which, from its great power of attracting water from organic bodies, gives very little water

to the starch-grains), and add tincture of iodine, the starch-grains do not become blue, but are coloured various tints, from bright wine-red to violet. The colours change to blue directly water is applied. The same result is obtained when dried potato-starch is placed in absolute alcohol, a considerable quantity of iodine dissolved in this, and water dropped in carefully and with frequent agitation, until the starch-grains are coloured: their colour will be from reddish to deep violet, but none will appear blue. A greater addition of water at once brings out the blue colour.

Analogous phænomena are displayed during the action of chloro-iodide of zinc upon dry starch. The latter is capable of abstracting water from the solution, and gradually becomes strongly swollen up through the influence of chloride of zinc. But this process requires much time; and the outermost layer of the granules especially opposes at first a resistance to the expansion. Hence the grains appear at first brown-red, like dry starch-grains saturated with iodine; subsequently this colour changes while they swell up (which often occurs irregularly and partially), into a bright blue. If, however, the quantity of the starch in proportion to the chloride of zinc solution is great, and, after complete swelling-up, forms with it a very tough, dense, and glutinous mass, the bright blue colour changes in the course of twenty-four or thirty-six hours, during the swelling-up and while the toughness of the mass increases, into a fine purple-red. If water is now added without fresh iodine, the colour changes rapidly into blue. Here evidently, at the commencement of the swelling-up of the grains, the quantity of water in the zinc solution is sufficient to supply the half-swollen granules with enough water for the production of the blue colour, while with the increasing expansion of the starch-grains it becomes again insufficient, and thus the blue colour is brought back to red.

If I have rightly comprehended the above-described phænomena, the reaction of cellulose and starch with iodine, far from being the only test by which to distinguish them, affords, *on the contrary, a character of no value for distinguishing between the two chemical compounds.*

Strictly speaking, Nägeli did not regard the colour which the said substances take with iodine as the only distinction between them; for he mentions as a second the circumstance that cellulose withstands solvents more strongly than starch, while starch-grains, on account of the cellulose they contain, are caused to swell up and dissolve with more difficulty than pure starch would be (p. 193). This statement is certainly true in respect to most solvents, and the complete insolubility of cellulose in water must

above all be brought forward as a distinctive character; it is, however, not universally valid. Ammoniated oxide of copper dissolves purified cellulose very quickly; but, so far as my experience goes, it is quite incapable of dissolving a starch-grain, only causing it to swell up. Another solvent for cellulose, which cannot dissolve starch, is the ferment in putrefying potatoes, discovered by Mitscherlich. Nägeli thinks the action of this upon cellulose must be attributed to its setting up decomposition in the proteine substances contained in the cell-membranes, and carrying this over to the cellulose, while, as the starch contains no proteine, it does not become decomposed. It is probable that this may be the true explanation; but, before we can admit it as correct, it must be proved by comparative observations on the action of this ferment upon purified cellulose and starch. I have no experience on this point.

If we agree with Nägeli in regarding that portion of the starch-grain insoluble in saliva as cellulose, we may name a number of other substances which dissolve cellulose but not starch-grains. In any case, it is a partial view to deduce the insolubility or the difficult solubility of starch-grains from the insolubility of the substance insoluble in saliva contained in them, since, on the other hand, this latter substance in a purified condition is very readily dissolved by many materials, while in the starch-grain it is protected from their solvent action by its combination with starch.

From what is above related, I find it impossible to admit that Nägeli has conceived the distinctions between cellulose and starch according to nature; still less am I convinced that he has arrived at proof of the view that the substance left of the starch-grains after the removal of the soluble part by saliva is identical with cellulose. The following facts will show that this substance behaves differently, with a number of reagents, from purified cellulose.

The grounds upon which Nägeli here rests lie especially in the reaction of this substance with iodine (p. 186), its assuming a copper-red or red-brown colour with aqueous solution of iodine, tincture of iodine, or iodide of zinc, and a blue colour when dried up with tincture of iodine and wetted with water, or treated with iodine and sulphuric acid.

The characters certainly indicate a great similarity to cellulose. I may mention, as a further agreement, that ammoniated oxide of copper dissolves both substances. But let us look at the differences.

In regard to physical properties, it must be observed that the substance of starch-grains is very brittle, while pure cellulose is perceptibly tough; further, that, as above-stated, the two substances act in opposite ways on polarized light.

In reference to the chemical reactions, I met with the following distinctions, in detailing which I shall, for the sake of brevity, simply use the terms *starch-grains* and *cellulose,* without especially mentioning that in each case I refer to starch-grains exhausted by saliva, and cellulose purified by Schulze's method.

Solution of caustic potash dissolves the starch-grains suddenly; cellulose swells up in it, but remains undissolved after many hours.

Solution of chloride of zinc and iodine, when concentrated, dissolves starch-grains instantly into a brownish-red fluid; cellulose does not swell perceptibly in it, and resists solution for days.

Ammoniated oxide of copper, to which so much carbonate of ammonia has been added that it will no longer act upon cellulose, dissolves the starch-grains instantly; when still more carbonate of ammonia is added, the starch is no longer dissolved.

Ammoniated oxide of nickel dissolves the starch-grains instantly; but cellulose is insoluble in it.

Nitric acid dissolves the starch-grains instantly; but cellulose bears long boiling in this acid mixed with chlorate of potash.

Hydrochloric acid dissolves the starch-grains immediately; cellulose is not perceptibly attacked by this acid.

Among these diversities, the different behaviour with polarized light forms the sharpest contrast; the other differences might be regarded rather as gradual, since they all agree in showing that the substance contained in the starch-grains is soluble in a number of media in which cellulose is only slightly or not at all soluble. Hence a question might be raised whether these diversities were sufficiently great to warrant the conclusion that the substance of the starch-grains is different from cellulose. In regard to this it must be fully borne in mind, in reference to the distinctions between the two substances relating to their solubility in many of the media named, especially in ammoniacal oxide of nickel, chloro-iodide of zinc, nitric and hydrochloric acids, that I tested the behaviour with these media of purified cellulose derived from a considerable number of plants which exhibited no important differences whatever in the behaviour of the membranes; so that these differences are as constant and striking as the difference between the various kinds of sugar.

If therefore we desire to distinguish from one another the hydrates of carbon of which the organic structures of plants are composed, by such reactions, there is abundant ground against ranging the substance of starch-grains exhausted of starch with cellulose, and for giving it a proper name (say *farinose*). However, I will not in this respect forestall the chemists, before whom the whole matter must come for definitive settlement.

Tübingen, February, 1859.

XXVI.—*Descriptions of newly-discovered Spiders captured by* James Yate Johnson, Esq., *in the Island of Madeira.* By John Blackwall, F.L.S.

The spiders here described were comprised in an extensive and very interesting collection of *Arachnida* made in the Island of Madeira, in the year 1858, by James Yate Johnson, Esq., who transmitted the whole to me for examination, kindly permitting me to describe such species as might appear to be new to science.

Tribe Octonoculina.

Family Drassidæ.

Genus Clubiona, Latr.

Clubiona albidula.

Length of the female $\frac{2}{5}$ths of an inch; length of the cephalothorax $\frac{3}{20}$; breadth $\frac{1}{10}$; breadth of the abdomen $\frac{1}{8}$; length of an anterior leg $\frac{1}{2}$; length of a leg of the third pair $\frac{3}{10}$.

The eyes are nearly equal in size, and are disposed in two transverse rows on the anterior part of the cephalothorax, the anterior row being situated immediately above its frontal margin; the intermediate eyes of both rows form a trapezoid, whose anterior side is rather the shortest, and those of each lateral pair are seated obliquely on a tubercle. The cephalothorax is oval, convex, glossy, depressed before, and broadly rounded in front; it is of a pale, dull yellowish colour, faintly tinged with red in the region of the eyes, and has an obscure soot-coloured band extending along the middle, from which an oblique line of the same hue passes on each side of the cephalic region. The falces are powerful, conical, vertical, and of a red-brown colour. The maxillæ are straight, and enlarged and rounded at the extremity: the lip is longer than broad, and truncated at its apex. These organs have a yellowish-brown hue, the lip being much the brownest. The sternum is oblong, heart-shaped, with minute prominences on the sides, opposite to the legs: the legs are slender and provided with hairs and fine sessile spines; the first pair is the longest, then the fourth, and the third pair is the shortest; each tarsus is terminated by two curved, pectinated claws, below which there is a small scopula. These parts, with the palpi, have a very pale yellowish hue. The abdomen is oviform, convex above, and projects a little over the base of the cephalothorax; it is thinly clothed with short hairs, and of a yellowish-white colour; the margin of the sexual organs forms an oval opening posteriorly, and has a dark reddish-brown hue.

This *Clubiona* was found among plants brought from the mountains in the vicinity of Estreito.

Clubiona decora.

Length of the female $\frac{5}{24}$ths of an inch; length of the cephalothorax $\frac{1}{10}$, breadth $\frac{1}{16}$; breadth of the abdomen $\frac{1}{12}$; length of a posterior leg $\frac{1}{4}$; length of a leg of the third pair $\frac{3}{20}$.

The cephalothorax is oval, thinly clothed with hairs, convex, glossy, with a slight, narrow indentation in the medial line, and is of a brownish-yellow colour. The eyes are disposed in two transverse rows on the anterior part of the cephalothorax, and are nearly equal in size; the anterior row, which is the shorter, is situated immediately above the frontal margin, and the two intermediate eyes of the posterior row are wider apart than they are from the lateral eyes of the same row. The falces are powerful, conical, and rather prominent: the maxillæ are straight, and greatly enlarged and rounded at the extremity: the lip is long, truncated and slightly hollowed at the apex, and its sides are nearly parallel. These organs have a red-brown hue, the maxillæ being the palest. The sternum is oval, with small eminences on the sides, opposite to the legs: the legs are moderately long, and are provided with hairs and sessile spines; the fourth pair is the longest, then the second, and the first and third pairs are equal in length; each tarsus is terminated by two curved, minutely pectinated claws, and below them there is a small scopula. These parts, with the palpi, which are short, have a pale, dull yellowish hue. The abdomen is of an oblong oviform figure, moderately convex above, and projects very little over the base of the cephalothorax; it is clothed with fine, silky, whitish hairs, and of a yellow-white colour; a band extends from the anterior extremity of the upper part, along the middle, fully one-third of its length, and is succeeded by a row of minute spots, which terminates at the coccyx; on each side of the posterior part there is a large patch composed of confluent oblique streaks, and there are two minute spots on each side of the spinners, and two below them; the band, spots, and patches are of a dark-brown colour; the sexual organs are moderately developed, and have a red-brown hue.

The male is smaller than the female, but the colours and the design formed by their distribution are similar in both sexes. The radial joint of the palpi is rather larger than the cubital joint, and projects a pointed apophysis from its extremity, on the outer side; the digital joint is oval, convex and hairy externally, concave within, comprising the palpal organs; these organs are moderately developed, not very complex in structure, with a black filiform spine which, originating near the middle of their inner side, curves round their extremity to the outer side, and are of a red-brown colour.

Specimens of this *Clubiona* were taken among plants growing in a garden 200 feet above the level of the sea.

Clubiona virgulata.

Length of the female $\frac{5}{24}$ths of an inch; length of the cephalothorax $\frac{1}{12}$; breadth $\frac{1}{14}$; breadth of the abdomen $\frac{1}{12}$; length of a posterior leg $\frac{7}{24}$; length of a leg of the third pair $\frac{1}{4}$.

The eyes, which are nearly equal in size, are disposed on the anterior part of the cephalothorax in two nearly straight transverse rows, the anterior row, which is the shorter, being situated immediately above the frontal margin; the intermediate eyes of both rows almost form a square, the anterior side being slightly the shortest, and the lateral eyes are rather the largest of the eight. The cephalothorax is convex, glossy, compressed before, and rounded on the sides, which are marked with furrows converging towards a slight narrow indentation in the medial line: the falces are conical, rather prominent, and armed with a few teeth on the inner surface: the maxillæ are straight, convex near the base, and somewhat enlarged and rounded at the extremity: the lip is nearly quadrate, the base being rather broader than the apex: the sternum is heart-shaped, with small eminences on the sides, opposite to the legs; the legs are long, provided with hairs and fine sessile spines, and each tarsus is terminated by two curved, pectinated claws. These parts, with the palpi, are of a yellow-brown colour, the lateral margins of the cephalothorax having a yellowish-white, and the space between the two rows of eyes a brown hue. The abdomen is of an oblong oviform figure, moderately convex above, and projects a little over the base of the cephalothorax; it is clothed with short hairs, and of a pale yellow-brown colour; a dark-brown band, which is palest in the medial line, extends from the anterior extremity of the upper part, along the middle, more than one-third of its length; this band tapers to its posterior extremity, on each side of which there is an oblong spot of the same hue; to these succeed three oblique dark-brown bars situated on each side of the medial line, whose enlarged outer extremities coalesce; and between these bars and the spinners there is a longitudinal row of minute contiguous spots of the same colour; the sexual organs are well developed, with a longitudinal septum in the middle, and have a dark red-brown hue.

Specimens of this species were discovered under stones near Funchal.

Genus Clotho, Walck.

Clotho lepida.

Length of the female $\frac{1}{12}$th of an inch; length of the cephalo-

thorax $\frac{1}{18}$; breadth $\frac{1}{24}$; breadth of the abdomen $\frac{1}{18}$; length of a posterior leg $\frac{5}{24}$; length of a leg of the third pair $\frac{3}{20}$.

The cephalothorax is oval, convex, glossy, pointed in front, and without an indentation in the medial line: the falces are short, conical, vertical, and somewhat divergent at the extremity: the maxillæ are enlarged and convex at the base, rounded at the extremity, and curved towards the lip, which is triangular; and the sternum is oval, with minute eminences on the sides, opposite to the legs: the legs are moderately long, and provided with hairs and fine spines; the fourth pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by two curved, pectinated claws, and below them there is a small scopula. These parts, with the palpi, which are inserted near the middle of the outer side of the maxillæ, are of a dull yellow colour, the sternum, which has some long dark-brown hairs on its margin, being the palest. The abdomen is oviform, convex above, and projects a little over the base of the cephalothorax; it is clothed with short hairs, and the upper part is of a pale red colour; the under part has a yellowish-white hue, faintly tinged with red; the sexual organs, which are not highly developed, are of a pale red-brown colour; the spinners have a pale yellowish-brown hue, and the two inferior ones are terminated by long soot-coloured papillæ. The eyes are closely grouped on the anterior part of the cephalothorax; four form a straight transverse row immediately above the frontal margin, which is fringed with long hairs, the two intermediate ones being the largest of the eight; the other four are placed in pairs directed obliquely inwards, behind each lateral eye of the front row; the three lateral eyes are near to each other, and form a short, slightly curved line whose convexity is directed outwards, and the posterior eye of each has an oval figure.

An adult female of this species was taken in a house among specimens of fossils. It appears to be most nearly allied to the *Enyo amaranthina* of M. Lucas, but differs from it in various particulars.

Family AGELENIDÆ.

Genus TEXTRIX, Sundevall.

Textrix obscura.

Length of the female, not including the spinners, $\frac{3}{8}$ths of an inch; length of the cephalothorax $\frac{1}{8}$; breadth $\frac{1}{9}$; breadth of the abdomen $\frac{3}{20}$; length of a posterior leg $\frac{9}{20}$; length of a leg of the third pair $\frac{2}{5}$.

The legs are moderately long, provided with hairs and spines, and are of a red-brown colour; the fourth pair is the longest, and the other three pairs are equal in length, though, from being

articulated to broader parts of the cephalothorax, the third appears to be longer than the second, and the second longer than the first; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The palpi resemble the legs in colour, and have a curved, pectinated claw at their extremity. The cephalothorax is large, elongated, much compressed before, and rounded and depressed on the sides, which are marked with furrows converging towards a narrow indentation in the medial line; it is thinly clothed with hairs, glossy, and of a dark-brown colour tinged with yellow along the middle; the immediate region of the eyes is the darkest, and a fine, longitudinal, brownish-black line occurs on the lateral margins. The falces are powerful, conical, vertical, convex at the base in front, armed with teeth on the inner surface, and have a very dark-brown hue. The maxillæ are enlarged and rounded at the extremity, and slightly curved towards the lip, which is nearly quadrate, being rather broader at the base than at the apex; and the sternum is heart-shaped. These parts are of a yellowish-brown colour, the base of the lip being the darkest. The eyes are disposed on the anterior part of the cephalothorax in two transverse, curved rows, having their convexity directed forwards; the four constituting the anterior row, which is slightly curved, are near to each other, and minute, the two intermediate ones being the smallest; and those of the posterior row, which is much curved, are larger and wider apart, the two intermediate ones being the largest of the eight. The abdomen is oviform, hairy, convex above, and projects over the base of the cephalothorax; it is of a brown colour densely freckled with black, the under part being the palest, and along the middle of the upper part an obscure series of yellowish-white angular lines extends, which have their extremities enlarged and their vertices directed forwards; the spinners have a brown hue, and the two superior ones are tri-articulate, much longer than the rest, and have the spinning-tubes disposed on the inferior surface of the terminal joint; the sexual organs are highly developed, rather prominent, and of a red-brown colour.

Specimens of *Textrix obscura* were found among stones in the neighbourhood of Funchal.

Family THERIDIIDÆ.

Genus THERIDION, Walck.

Theridion luteolum.

Length of the female $\frac{3}{16}$ths of an inch; length of the cephalo-

thorax $\frac{1}{12}$; breadth $\frac{1}{16}$; breadth of the abdomen $\frac{1}{10}$; length of an anterior leg $\frac{3}{8}$; length of a leg of the third pair $\frac{4}{25}$.

The eyes are seated on black spots, and are closely grouped on the anterior part of the cephalothorax in two transverse rows; the four intermediate ones form a square, the two anterior ones, which are placed on a tubercle, being the smallest and darkest of the eight; the eyes of each lateral pair are seated on a tubercle, and are contiguous. The cephalothorax is short, convex, glossy, compressed before, and rounded on the sides, which are marked with slight furrows converging towards a large indentation in the medial line: the falces are slender, conical, and vertical: the maxillæ are obliquely truncated at the extremity, on the outer side, and are inclined towards the lip, which is triangular but rounded at the apex: the sternum is heart-shaped: the legs are long, slender, and provided with hairs; the first pair is the longest, then the fourth, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base: the palpi have a curved, pectinated claw at their extremity: the abdomen is oviform, thinly clothed with hairs, convex above, and projects over the base of the cephalothorax. This spider is entirely of a pale, dull yellowish colour, the falces having a faint tinge of red.

An immature female of this species was discovered on a piece of wood in a house.

Genus Latrodectus, Walck.

Latrodectus distinctus.

Length of the female $\frac{1}{5}$th of an inch; length of the cephalothorax $\frac{1}{12}$; breadth $\frac{1}{16}$; breadth of the abdomen $\frac{1}{10}$; length of an anterior leg $\frac{3}{8}$; length of a leg of the third pair $\frac{5}{24}$.

The cephalothorax is oval, convex, particularly in the cephalic region, glossy, with slight furrows on the sides, which converge towards a large indentation in the medial line: the falces are conical and vertical: the maxillæ are obliquely truncated at the extremity, on the outer side, and inclined towards the lip, which is broad and semicircular: the sternum is heart-shaped: the legs are long and provided with hairs; the first pair is the longest, then the fourth, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base: the palpi are short, and have a small, curved, pectinated claw at their extremity. These parts are of a dull yellowish-brown colour; the extremity of the falces is faintly tinged with red, and a fine black line extends along each lateral margin of

the cephalothorax. The eyes, which are seated on black spots, are disposed in two transverse, nearly straight rows on the anterior part of the cephalothorax; the four intermediate ones form a square, the two anterior ones, which are placed on a tubercle, being the smallest and darkest of the eight; the eyes of each lateral pair are placed obliquely on a tubercle, and are near to each other. The abdomen is oviform, thinly clothed with hairs, convex above, and projects over the base of the cephalothorax; it is of a dull black hue, the under part being tinged with brown, and has a curved band at the anterior extremity of the upper part, a row of four spots in the medial line, which diminish in size as they approach the spinners, the first having a semicircular form, two spots opposite each extremity of the curved band, and four others on each side, the two intermediate ones being oblong, oblique, and nearly in contact; these spots and the curved band have a yellowish-white colour; a whitish line extends along each side of the under part to the spinners, which lines, with the coccyx, have a pale yellow-brown hue, that of the branchial opercula being yellowish white.

This *Latrodectus*, which, by the disposition of its eyes and the structure of its oral apparatus, makes a near approach to the *Theridia*, was captured among herbage growing on the Fossil-bed, at an elevation of 200 feet above the level of the sea.

Family Linyphiidæ.

Genus Linyphia, Latr.

Linyphia Johnsoni.

Length of the female $\frac{1}{5}$th of an inch; length of the cephalothorax $\frac{1}{12}$; breadth $\frac{1}{18}$; breadth of the abdomen $\frac{1}{12}$; length of an anterior leg $\frac{7}{18}$; length of a leg of the third pair $\frac{1}{4}$.

The eyes, which are unequal in size, are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones form a trapezoid whose anterior side is much the shortest, and those of each lateral pair are placed obliquely on a small tubercle, and are contiguous; the posterior eyes of the trapezoid, which are seated on a tubercle, are much the largest, and the anterior ones rather the smallest of the eight. The cephalothorax is oval, convex, glossy, with an indentation in the medial line; it is of a dull yellowish-brown colour, with a broad, longitudinal, black band in the middle, and another of the same hue extending along each lateral margin. The falces are long, powerful, conical, vertical, armed with teeth on the inner surface, and of a yellowish-brown colour faintly tinged with red at the extremities, which are rather divergent. The maxillæ are

strong, straight, and somewhat quadrate, having the exterior angle at the extremity curvilinear; and the lip is semicircular and prominent at the apex. These organs are of a dark-brown hue, with yellowish-brown extremities. The sternum is heart-shaped, and of a brown-black colour. The legs are long, slender, provided with hairs and fine spines, and have a yellowish-brown hue, with a small dark-brown annulus at the extremity of the tibiæ and metatarsi; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The palpi are slender, and resemble the legs in colour. The abdomen is oviform, convex above, and projects over the base of the cephalothorax; it is sparingly clothed with hairs, and of a dull yellowish-brown colour faintly tinged with olive-green, and freckled with white on the upper part; a brownish-black line, slightly ramified at its posterior extremity, extends along the middle, and a broad, irregular, longitudinal band of the same hue, bounded both above and below by a parallel white band, the latter of which is much the more conspicuous, occurs on the upper part of each side; these brownish-black bands meet above the spinners, and a broad band of the same hue extends along the middle of the under part.

I have dedicated this *Linyphia*, which was taken in the vicinity of Funchal, to James Yate Johnson, Esq., resident in Madeira, to whom I am indebted for opportunities of inspecting numerous highly interesting specimens of *Araneidea* from that island and the Dezertas.

Family Epeïridæ.

Genus Epeïra, Walck.

Epeïra diversa.

Length of the female $\frac{1}{4}$th of an inch; length of the cephalothorax $\frac{1}{10}$; breadth $\frac{1}{12}$; breadth of the abdomen $\frac{1}{6}$; length of an anterior leg $\frac{3}{10}$; length of a leg of the third pair $\frac{1}{5}$.

The legs are moderately long and provided with hairs; the first pair is the longest, then the fourth, and the third pair is the shortest: each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base: the palpi are short, and have a curved, pectinated claw at their extremity: the cephalothorax is convex, glossy, slightly compressed before, and rounded on the sides, which are marked with furrows converging towards a large indentation in the medial line. These parts have a yellow-brown hue; the cephalothorax, which is the darkest, has narrow, dark-

brown, lateral margins, and the legs are marked with a few brown spots and annuli. The falces are powerful, conical, vertical, and armed with a few teeth on the inner surface: the maxillæ are straight, and somewhat enlarged and rounded at the extremity. These organs are of a red-brown colour, the maxillæ being the paler. The lip is semicircular, and the sternum is heart-shaped: both have a dark-brown hue, the lip being the darker. The eyes, which are nearly equal in size, are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones form a square, the two anterior ones being placed on a tubercle, and those of each lateral pair are seated obliquely on a tubercle, and are contiguous. The abdomen is short, broad, ovate, convex above, and projects over the base of the cephalothorax; it is thinly clothed with hairs, and has on the upper part a large and somewhat oval figure, with sinuous margins bordered with black, the two posterior lobes of which are the most prominent; it is of a dark greyish-brown colour, densely freckled with minute white spots; the undulations of the black margins are followed by an imperfectly-defined whitish band; and a white spot, whose posterior extremity is somewhat bifid, occurs in the medial line of the anterior part of the large oval figure; the sides and a broad space above the spinners are of a greyish-brown colour, thickly freckled with dull white, a brownish-black band extending along the anterior part of the former, and a fine streak of the same hue occupying the medial line of the latter; the under part has a greyish-brown hue freckled with dull white; a broad brown-black band, bordered laterally with white and freckled with yellowish white, extends along the middle, and two black and white spots, disposed alternately, are situated on each side of the spinners; the sexual organs are moderately developed, and of a dark red-brown colour.

Adult females of this species, which is remarkable in having the fourth pair of legs longer than the second pair, were discovered among herbage growing on the Fossil-bed.

Epeïra hortensis.

Length of the male $\frac{1}{5}$th of an inch; length of the cephalothorax $\frac{1}{10}$; breadth $\frac{1}{12}$; breadth of the abdomen $\frac{1}{12}$; length of an anterior leg $\frac{1}{3}$; length of a leg of the third pair $\frac{1}{4}$.

The cephalothorax is moderately convex, compressed before, rounded on the sides, and has an indentation in the medial line; it is clothed with hoary hairs, and of a red-brown colour, with an irregular black band on each side, extending from the lateral eye about two-thirds of its length; these bands are much the narrowest at their anterior extremity, and each projects an an-

gular point from its inner margin towards the medial line. The falces are slender, conical, vertical, and of a yellowish-red hue, with a dark-brown spot at the extremity, towards the outer side. The maxillæ are short, straight, powerful, and enlarged and rounded at the extremity; and the lip is semicircular, but somewhat pointed at the apex. These organs have a dark-brown hue, with pale yellowish-brown extremities. The sternum is heart-shaped, with small eminences on the sides, opposite to the legs; it is of a brown-black colour, with a broad, yellowish-white band extending along the middle, which projects two points from each side into the dark margins. The eyes are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones form a square, the two anterior ones being placed on a tubercle, and the eyes of each lateral pair are placed obliquely on a minute tubercle and are contiguous, the anterior one being the smallest of the eight. The abdomen is oviform, convex above, and projects over the base of the cephalothorax; the upper part is clothed with whitish silky hairs, and is freckled with dull yellow at its anterior extremity, near which there are four minute spots forming a curved transverse row whose convexity is directed backwards, the two intermediate ones being the smallest; a minute spot, followed by two streaks, occurs on each side of the medial line, to which succeeds a transverse curved row of very minute spots whose convexity is directed upwards; these spots and streaks have a brownish-black hue; the lower region of the sides and the under part are of a brown-black colour, a somewhat dentated yellowish-white band extending along each side of the latter; the branchial opercula are of a reddish-brown colour, and that of the spinners is yellowish-brown, the extremity of the superior pair having a brown-black hue on the upper surface. The legs are long, slender, and supplied with hairs and fine spines; the femora of the anterior pair are of a very dark-brown colour, that of the femora of the three other pairs being yellowish-brown; all are tinged with red at the extremity, and the other joints have a red-brown hue; the femora of the third and fourth pairs have a longitudinal black line on their anterior surface, and the coxæ of all the legs have a black spot on each side; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by the customary number of claws of the usual structure. The palpi are short, and of a pale yellow colour, with the exception of the digital joint, which has a dark-brown hue tinged with red; the cubital and radial joints are short; the former projects a long bristle from its extremity in front, and the latter is produced and fringed with hairs on the inner side; the digital joint is oval, with a process at its

base curved outwards; it is convex and hairy externally, concave within, comprising the palpal organs, which are very highly developed, very prominent, with a strong, curved, black spine, connected with a membrane, near the middle, whose prominent point is directed outwards: the colour of these organs is red-brown. The digital joints have their convex sides directed towards each other.

The spider described above was captured among plants in a garden at an elevation of 200 feet above the level of the sea.

Tribe Senoculina.

Family Dysderidæ.

Genus Oonops, Templeton.

Oonops concolor.

Length of the female $\frac{1}{16}$th of an inch; length of the cephalothorax $\frac{1}{32}$; breadth $\frac{1}{48}$; breadth of the abdomen $\frac{1}{32}$; length of a posterior leg $\frac{1}{16}$; length of a leg of the third pair $\frac{1}{24}$.

The eyes are oval, and are closely grouped in pairs on a black spot at the anterior part of the cephalothorax: two pairs are placed laterally, the anterior eye of each being the largest and the posterior one much the smallest of the six; and the third pair is intermediate, the eyes which constitute it being in contact. The cephalothorax is oval, convex, glossy, and without an indentation in the medial line. The falces are short, conical, and vertical. The maxillæ are convex near the base, obliquely truncated at the extremity, on the outer side, and inclined towards the lip, which is triangular. The sternum is heart-shaped and glossy, with slight eminences on the sides, opposite to the legs. The legs and palpi are moderately robust, and are provided with hairs; the fourth pair of legs is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by two curved, pectinated claws. The abdomen is oviform, depressed, glossy, thinly clothed with short hairs, and projects a little over the base of the cephalothorax. This spider is entirely of a reddish-brown colour, the legs, palpi, and spinners, which are prominent, being the palest.

The sexes resemble each other in colour; but the male is rather the smaller, and its palpi are very remarkable in structure. Unfortunately the palpi of the only male in the collection were too much injured to be described with exactness; the humeral joint appeared to be small, somewhat conical, and articulated by its apex to the cubital joint, which was large, very tumid, and convex at the base, and the radial and digital joints were small.

Specimens of this minute spider were found in a house among loose papers.

Genus Œcobius, Lucas.

Œcobius navus.

Length of the female, not including the spinners, $\frac{1}{12}$th of an inch; length of the cephalothorax $\frac{1}{24}$; breadth $\frac{1}{24}$; breadth of the abdomen $\frac{1}{24}$; length of an anterior leg $\frac{5}{20}$; length of a leg of the third pair $\frac{5}{20}$.

The cephalothorax is circular, glossy, convex above, particularly in the cephalic region, with a large indentation in the medial line, and the frontal margin, which is produced, covers the base of the falces; it is of a pale brownish-yellow colour, with a longitudinal brown-black band in the middle, whose anterior extremity is much the broadest, narrow black lateral margins, above each of which three spots of the same hue are disposed in a parallel row, and two black spots of a larger size situated in front. The falces are slender, subcylindrical, and vertical: the maxillæ are short, convex near the base, pointed at the extremity, and strongly inclined towards the lip, which is triangular: the sternum is short, broad, and heart-shaped: the legs are rather robust, provided with hairs, equal in length, and each tarsus is terminated by two curved, pectinated claws: the palpi, which are strong, somewhat pediform, and inserted near the middle of the outer side of the maxillæ, have a curved, pectinated claw at their extremity. These parts are of a very pale brownish-yellow colour; the sternum and maxillæ are the palest, and the base of the lip, a few spots on the palpi, and numerous annuli on the legs have a brownish-black hue. The abdomen is oviform, thinly clothed with hairs, convex above, and projects over the base of the cephalothorax; it is of a pale yellowish-brown colour spotted with white on the upper part; there is a large curved band at the anterior part, contiguous to the cephalothorax, whose bifid extremities extend to the sides; two minute spots, placed transversely, occur near the superior margin of the band, and are followed by angular lines forming a W, to which succeed three triangular spots whose vertices are in contact, or nearly so, the anterior one being much the largest, and the sides are marked with spots and oblique streaks; the band, spots, and streaks have a black hue; and a triangular space, conspicuously spotted with white, whose vertex touches the coccyx, is bordered with black; the spinners are of a pale yellowish-brown colour; the two superior ones are long, triarticulate, and have the spinning-tubes arranged along the inferior surface of their terminal joint, which has a dark-brown hue on its superior surface; and a short brownish-black streak, enlarged at its ante-

rior extremity, passes from each side of the spinners to the under part. The eyes are grouped on the cephalic convexity; the four anterior ones form a slightly curved transverse row, whose convexity is directed upwards, and the two intermediate ones are more distant from each other than from the lateral ones; the two posterior eyes are much the largest and darkest of the six; they are wide apart, and are situated behind the lateral eyes of the anterior row, which are the smallest and lightest-coloured.

Immature specimens of this species were discovered under stones in the neighbourhood of Funchal. If the equal length of the legs of this spider be a permanent character, and not attributable to its immaturity, the genus *Œcobius*, in this particular, will require to be amended.

XXVII.—*On some additional Species of Nudibranchiate Mollusks from Ceylon.* By E. F. Kelaart, M.D.

Doris Elizabethina, Kel.

Body half an inch long. Mantle broad, spotted with purple on the back; margin white, spotted with large light-blue spots. A row of crimson spots between the line of blue spots and the purple-coloured back. Under surface of mantle whitish, with a pink shade. Tentacles purplish brown, white-tipped, laminated. Branchiæ six, small, bipinnated, of a grizzled grey colour. Foot whitish, upper surface crimson. Mouth with a small veil.

This elegantly-coloured *Doris* was obtained in deep water near the Pearl Banks of Aripo. I have named it in compliment to one who takes more than an ordinary interest in my zoological pursuits.

Doris Diardi, Kel.

Small. Body ⅓rd of an inch long, spotted with blue. Mantle spotted with blue and white; margin lined with larger blue spots; under parts blue. Dorsal tentacles red, clavate, laminated. Branchiæ eight, short, pinnated; white, with a red margin. Foot blue; upper surface spotted with blue. Mouth surrounded by a bilobated veil.

This very rare species was obtained by M. Diard of Java, during his late visit to the Pearl Banks of Aripo. He found it on a pearl-oyster shell from the Modregam Bank. I have named it in compliment to the able and distinguished discoverer (the pupil and friend of Cuvier and Lamarck), who was recently engaged in researches in Ceylon.

Doris Lockyerana, Kel.

Body $3\frac{1}{2}$ inches long, brown. Mantle broad, oval, purplish brown, and figured with yellowish-brown irregular designs, like carpet-work. Under surface of mantle white, and maculated with large brown spots; a dark brown line runs near the white margin. Dorsal tentacles large, clavate, slightly truncated, laminated, of a pale red colour. Branchiæ six, pinkish, bipinnated. Foot purplish, shorter than the mantle. Oral tentacles short, pointed.

Found in deep water, Pearl Banks of Aripo. I have named this splendid species in compliment to Major-General Lockyer, C.B., with whose approval my zoological services were secured by the Ceylon Government.

Doris Tennentana, Kel.

Body 1 inch long, white. Mantle white, with a faint bluish shade, and spangled with golden-coloured and purple spots. Margin cærulean blue. Dorsal tentacles clavate, purplish red, tipped with white, laminated. Branchial plumes red, numerous, 12 to 15, linear, bipinnated. Foot white, upper surface spotted with yellow. Oral tentacles white, with a yellow margin. Under surface of mantle white, with bluish reflexions.

This beautiful species (allied to *Doris preciosa*) was obtained from the Cheval Paar Pearl Banks of Ceylon. I have named it in honour of Sir James Emerson Tennent, who, although long absent from Ceylon, continues to take great interest in the natural history of the island.

Doris ariponensis, Kel.

Body $1\frac{1}{4}$ inch long, pale purple. Mantle pale purple, spotted with black. Dorsal tentacles black, laminated. Branchiæ black, 12 to 15, small, linear, bipinnated.

Found in shallow water near the Doric, Aripo.

Doris Humberti, Kel.

Body $\frac{1}{3}$rd of an inch long, white. Mantle spotted with purple and brown; margin white, with a row of bright-red spots on the edge; under parts white. Dorsal tentacles red, spotted with white, clavate, laminated. Branchiæ nine, small, dendritic or irregularly pinnated, red and spotted white. Foot white, a few red spots on the upper surface. Oral tentacles small, bluntly pointed.

M. Humbert, Curator of the Museum of Geneva, found this

very pretty species on an old oyster shell on the Pearl Banks of Aripo, during the fishery of 1859, when I had the pleasure of meeting him there. I have named it in honour of the discoverer, with whom I have spent many happy hours at Aripo.

M. Humbert also found a small white *Doris*, with a black- or deep-blue-margined mantle. The creature was scarcely $\frac{1}{8}$th of an inch in length, and looked like the young of *Doris Maccarthiana*, from its narrow mantle and exposed body. There is also a white species of *Doris* with a black edge to the mantle, described by Rüppel.

The following are other Nudibranchiate mollusks found in or near the Pearl Banks of Aripo, in the months of February, March, and April, 1858:—

Doris funebris, *D. marmorata*, *D. grisea*, *D. atrata*, *D. rubra*, *Trevelyana*, *zeylanica*, *Pleurobranchus citrinus*, Rüppel.

I have also found a species of *Diphyllidia*, which is provisionally named

Diphyllidia marmorata, Kel.

Body $1\frac{1}{4}$ inch long, spotted with white. Mantle above yellowish brown, and marbled with darker brown or greenish brown. Tentacles slightly laminated. Veil white, with a yellow margin. Under parts of mantle greenish brown. Branchiæ indistinct, in longitudinal striæ under the mantle. Foot white, longitudinally grooved in centre of posterior third.

Genus Bornella, Gray.

Animal elongated. Dorsal tentacles retractile into branched sheaths. Head with stellate processes. Back with two rows of cylindrical, branched, gastric processes, to which small dendritic gills are attached. Foot very narrow.

Bornella Hancockana, Kel.

Body $1\frac{3}{4}$ inch long, narrow, tapering, rounded on the back, and slightly flattened on the sides. Anterior half of an opake white, and posterior half of a light brown colour, reticulated with red throughout. Blackish viscera visible in some parts of the body and branchiæ. Tentacular sheaths longer than branchiæ, and divided at their extremities into three or four tentacular or digitate processes similar to those of the branchiæ. Sheath coloured and reticulated as the body. Tentacles small, clavate, pointed, and slightly plumose, circularly laminated, of a pale yellowish colour. Head indistinct; on each side a small cluster of short, unequal, tentacular prolongations of a white colour, a few with a red ring near the

extremity. Branchiæ compound, in four or five pairs on the sides of the body, the anterior ones bifurcated or trifurcated into papillose, conical, pointed processes; and on the inner side of the stem of each are two or three transparent, almost colourless, plumose and branched appendages. Stem coloured like the body; papillæ white, with subterminal crimson-red ring. Foot broad, tapering, canaliculated, white, pellucid. Ova yellow.

This species combines some of the characters of a true *Eolis* with those of the new genus *Dendronotus*. The combination of plumose and papillose ramification of the branchiæ is very curious. The internal viscera correspond with those of the genus *Dendronotus*. I have named the species in honour of one who, with his associate Mr. Alder, has separated the arborescent forms of Eolididæ from the old genus *Tritonia*.

Eolis Skinneri, Kel.

About 4 lines long; white. Dorsal tentacles opake white, with three granular rings. Oral tentacles long, with a subterminal reddish ring. Branchiæ in five sets, of three or four papillæ in each; opake white, with a basal red ring.

Found by Major Skinner, Auditor-General, on sea-weed near the South Gate, Fort of Colombo.

XXVIII.—*Descriptions of new Genera and Species of Phytophagous Insects.* By J. S. Baly, Esq.

[Continued from p. 128.]

Fam. Galerucidæ.

Genus Diabrotica, Erichs.

Diabrotica dimidiata.

D. ovata, convexa, flavo-fulva, nitida, elytris vix ante medium ad apicem abdomineque cæruleo-nigris; thorace subquadrato, vix pone medium transverse sulcato; unguibus piceis.—Long. 6 lin.

Hab. Banks of the Napo.

Diabrotica regalis.

D. ovata, convexa, fulva, nitida; capite, pectore, scutello elytrisque nigris, his minute punctatis, a basi apicem versus ampliatis, margine exteriore maculisque decem fulvis, harum 4 ante, 4 vix pone medium, et 2 ante apicem positis; antennarum articulis tribus basalibus tribusque ultimis fulvis, ultimi apice nigro, articulis in-

termediis, tibiis tarsisque piceis; thorace subquadrato, convexo, basi unifoveolato.—Long. 4¼ lin.

Hab. Columbia?

Diabrotica Clarkella.

D. pallide rufo-brunnea, nitida; capite, thorace subquadrato elytrisque viridibus, his oblongo-ovatis, convexis, lateribus prope medium obsolete carinatis, tenuiter subcrebre punctatis, plaga magna transversa communi bascos rufo-brunnea, posticeque fascia communi arcuata flava, extrorsum abbreviata, instructis.—Long. 3½ lin.

Hab. Brazil.

Diabrotica arcuata.

D. elongata, pallide flava, nitida, tibiis, tarsis, pectore, scutello capiteque nigris; antennarum articulis penultimis duobus articulique ultimi basi albidis; thorace latitudine paullo longiore, disco obsolete transverse bi-impresso; elytris oblongis, convexis, a basi ad apicem leniter ampliatis, crebre punctatis, macula oblonga humerali, basi connexa, linea suturali longe ante medium abbreviata, fasciaque communi arcuata, pone medium posita, cyaneis.—Long. 4¼ lin.

Hab. Bogota.

Diabrotica exclamationis.

D. elongata, nigra, nitida; elytrorum utrumque limbo laterali, vitta mediali postice abbreviata, punctoque subapicali, coxis, trochanteribus femorumque basi, albidis; thoracis subquadrati lateribus antennarumque articulis secundo tertioque obscure piceis.—Long. 3 lin.

Hab. Brazil.

Diabrotica vespertina.

D. fulva, nitida, capite nigro, antennarum articulis quatuor ultimis albidis; thorace transverso, disco trasverse excavato et obsolete tri-impresso; elytris ovatis, crebre punctatis, læte metallico-viridibus.

(*Mas.*) Elytris apicem versus prope suturam carina arcuata, medio unituberculata, et cum illa elytri alteri spatium subelevatum minus punctatum includente, instructis.—Long. 4–5 lin.

Hab. Bank of the Napo.

Diabrotica Batesii.

D. fulva, nitida, capite nigro, antennis piceis, harum articulis tribus ultimis albis, quatuor basalibus subtus fulvis; thorace transverso, disco transverse depresso, utrinque impresso, rufo-fulvo, maculis duabus piceis; elytris oblongis crebre punctatis, obscure-olivaceis, limbo exteriore fulvo.

(*Mas.*) Elytris apicem versus prope suturam spatio semiovato elevato, minus crebre punctato instructis.—Long. 2¾–3 lin.

Hab. Ega, Upper Amazons. Collected by Mr. Bates.

Diabrotica Erichsoni.

D. fulva, nitida, capite (antennarum articulis quatuor ultimis prætermissis) nigro; elytris oblongis, crebre punctatis, subrugosis, utroque vittis tribus obsolete elevato, plumbeis, margine lævi, fulvo; thorace transverso, disco fortiter transverse bi-impresso, basi unifoveolato.

(*Mas.*) Elytris apicem versus prope suturam carina oblonga nitida instructis, vittis obsoletis, antennarum articulis basalibus subtus fulvis, ultimi apice nigro.—Long. maris 5 lin., fœm. 4 lin.

Hab. Banks of the Napo.

Diabrotica triplagiata.

D. supra nigra, nitida, antennarum articulis tribus ultimis flavo-albidis, ultimi apice nigro, articulis ante apicem album nigro-piceis, quinque basalibus subtus fulvis; thorace transverso-quadrato, disco transverse excavato, utrinque impresso, lateribus sinuatis, flavo marginatis; scutello trigonato, apice subacuto; elytris oblongis, tenuiter subcrebre punctatis, obsolete carinatis, flavis, plaga magna communi subquadrata, a basi ad medium extensa, et utriusque macula postica obscure metallico-olivaceis; subtus flava, tibiis extrorsum femorumque dorso piceo-lineatis.

(*Mas.*) Elytris apicem versus prope suturam, carina brevi elevata instructis.—Long. 4–4½ lin.

Hab. Banks of the Napo.

This species probably varies in having the posterior patches on the elytra confluent at the suture.

Diabrotica fraterna.

D. supra nigra, nitida, thoracis lateribus antennisque flavis, his (articulis quatuor ultimis exceptis) dorso nigro-signatis; thorace tranverso, disco transverse fortiter sulcato, ante basin breviter transverse canaliculato, lateribus ante medium ampliatis; scutello elongato-trigonato, apice obtuse truncato; elytris oblongis, tenuiter crebre punctatis, obscure metallico-olivaceis, limbo exteriore fasciaque prope medium flavis; subtus fusca, pedibus obscure fulvis, femoribus dorso, tibiisque extrorsum, nigris.—Long. 4½ lin.

Hab. Banks of the Napo.

Diabrotica Adonis.

D. nigra, nitida, antennarum articulis ultimis tribus, thorace transverso pedibusque flavo-albis; his tarsis, tibiis quatuor anticis fere totis posticisque apice nigris; elytris oblongis, tenuiter crebre

punctatis, cyaneis, limbo exteriore fasciaque lata centrali flavo-albidis; thorace fortiter transverse arcuatim sulcato, sulco obsolete bi-impresso.

(*Mas.*) Elytris apicem versus prope suturam tuberculo oblongo instructis.—Long. 4 lin.

Hab. Venezuela.

Diabrotica ornata.

D. flavo-fulva, nitida, capite nigro, unguibus antennisque piceis; thorace rufo-fulvo, transverso, disco transverse depresso et utrinque fortiter impresso, basi unifoveolato; elytris oblongis, crebre punctatis, metallico-viridibus, limbo exteriore fasciaque prope medium flavis; antennis albidis, articulis basalibus quatuor subtus, ultimisque quatuor totis, obscure flavis.

(*Mas.*) Elytris apicem versus prope suturam carina arcuata instructis.—Long. maris 5, fœm. 4 lin.

Hab. Peru.

Genus Œdionychis, Latr.

Œdionychis Batesii.

Œ. late ovata, convexa, obscure fusco-fulva, nitida; antennis (basi picea excepta) scutelloque nigris, unguibus posticis, vertice thoraceque rufo-fulvis, hoc ante basin leniter transverse impresso, basi ipsa utrinque nigro marginata, lateribus late reflexis, fulvis; elytris tenuiter punctatis, flavo-albis, maculis 13, seriebus transversis quatuor, 4–3–4–2 dispositis, nigro-cæruleis; tarsis, tibiis ad apicem femorumque dorso, pallide piceis.—Long. 4½ lin.

Hab. Ega, Upper Amazons.

Œdionychis bilimbata.

Œ. late ovata, fulva, nitida, antennis (basi excepta), vertice scutelloque nigris; elytris crebre punctatis, rufo-testaceis, margine exteriore flavo, basi infra humeros, vittaque submarginali, postice attenuata, cyaneis.—Long. 3½–5 lin.

Hab. Brazil.

Œdionychis bella.

Œ. ovata, nitido-nigra, facie inferiore utrinque flavo-maculata, abdominis margine thoraceque rufo-fulvis; elytris tenuiter punctatis, margine exteriore, apice dilatato, lineaque transversa submaculariformi prope medium, sutura abbreviata, flavis.—Long. 4 lin.

Hab. Peru.

Œdionychis tetraspilota.

Œ. ovata, nigra, nitida, thoracis lateribus albidis; elytris metallico-purpureis, tenuissime punctatis, utroque maculis duabus magnis, una prope medium, altera apice, positis, flavo-albis.—Long. 3½ lin.

Hab. Brazil.

Œdionychis bifasciata.

Œ. elongato-ovata, fulva, nitida, antennis (basi excepta) femorumque posticorum apice nigris; supra flava, elytrorum fasciis latis duabus, extrorsum abbreviatis, una basi, altera pone medium, positis, nitido-metallico-cæruleis.—Long. $3\frac{3}{4}$ lin.

Hab. Amazons.

Œdionychis ornata.

Œ. elongato-ovata, fusco-fulva, pedibus antennisque piceis, supra albidis, vertice nigro; elytris indistincte punctatis, nitidissimo-cupreis, margine exteriore fasciisque duabus, harum una vix ante medium, altera prope apicem, sutura abbreviata, albidis.—Long. $3\frac{1}{2}$ lin.

Var. A. Antennis pedibusque anterioribus quatuor, nigris.

Hab. Guatemala, Amazons, Cayenne. Var., Venezuela.

Œdionychis Salléi.

Œ. subovata, pallide flava, nitida, capite, antennarum apice scutelloque nigris; elytris oblongis, crebre tenuiter punctatis, plaga magna discoidali, a basi fere ad apicem extensa, margineque laterali, postice abbreviato, cæruleo-nigris; antennarum articulis basalibus quatuor supra, tarsisque fuscis.—Long. 3 lin.

Hab. Mexico.

Œdionychis semifasciata.

Œ. ovata, flavo-albida, nitida, corpore subtus antennisque nigris, capite rufo-fusco, nigro-maculato; margine laterali indistincte, basi extrema fasciisque duabus, utrinque abbreviatis, harum prima pone medium, secunda flexuosa, prope apicem posita, pallide rufo-brunneis; tibiis tarsisque posticis nigro-piceis.—Long. 4 lin.

Hab. Brazil.

Œdionychis quadrivittata.

Œ. ovata, fulva, antennis extrorsum nigris; elytris ovatis, tenuiter crebre punctatis, margine complanato modice dilatato, utroque vittis duabus, a basi fere ad apicem extensis, apice confluentibus, rufo-brunneis.—Long. 5 lin.

Hab. Brazil.

Œdionychis trivittata.

Œ. oblonga, convexa, pallide picea, nitida, supra (capite excepto) fulva, thorace elytrisque crebre punctatis, his sutura et utroque vitta discoidali a basi fere ad apicem extensa, rufo-fuscis.—Long. $4\frac{1}{2}$ lin.

Hab. Brazil.

Œdionychis submarginata.

Œ. ovata, nigro-picea, nitida, facie inferiore, thorace elytrisque punctatis, albidis, illo maculis duabus disco transverse positis,

his sutura vittaque submarginali, nigris; antennis nigris, articulis basalibus obscure piceis.—Long. 3½ lin.

Hab. Brasil.

Œdionychis virginella.

Œ. oblongo-ovata, nitido-fusco-fulva, tibiis tarsisque posticis, pedibus quatuor anticis antennisque rufo-fuscis, thorace elytrisque albidis, his subrectis, lævibus, obsolete punctulatis.—Long. 3¼ lin.

Hab. San Paulo, Brazil.

XXIX.—*On Digestive Power in the* Actiniæ. By E. W. H. Holdsworth, F.L.S. &c.

To the Editors of the Annals of Natural History.

Gentlemen,

Mr. G. H. Lewes having recently published, in 'Seaside Studies,' his views of the digestive powers of the *Actiniæ*, criticism becomes allowable; I therefore propose to offer a few remarks on the subject, and to relate my observations made during a long course of study of these animals. If I cannot always agree with Mr. Lewes, still I have no wish to depreciate the value of his researches; and my sole object in stating what I have observed is to aid in the settlement of the point in dispute.

In 'Seaside Studies,' page 207, will be found the brief query —"Do the Actiniæ digest at all?" Mr. Lewes then proceeds to give his definition of digestion, and concludes by saying,— "Thus we see that solubility and transformation are the two digestive effects, to produce which two agencies are needful— the mechanical and chemical." The first is the one adopted by the author as the *sole* means of preparing the food for assimilation in the *Actiniæ*.

In order to test the accuracy of this opinion, it will be desirable to notice what takes place when these polypes are fed. Any one who has healthy specimens in an aquarium can easily try the experiment, and will observe something like the following process:—

A piece of meat, of suitable size, after being conveyed to the mouth of the polype, is taken into the membranous tube, generally considered as the stomach, where it remains for a few *minutes* only, and sometimes barely stops there; it then passes into the general cavity of the body, and finally rests at its lowest part. The animal now fills itself with water until every part is distended to the utmost, and in this state it continues for several hours, not unfrequently for two days, the average time perhaps

being about twenty hours. Whilst in this condition, some species become sufficiently transparent to enable us to discern a great part of their internal structure; and a vertical view of the polype shows the stomach suspended like a single flat membrane from the oral disk. On looking through the sides of the animal, the food may be observed at the bottom of the great cavity—usually in the centre, sometimes a little on one side—and resting on the edges of the converging septa. In this position it stays until *whatever part of it is not required by the polype* is finally returned through the mouth. I shall presently refer to the condition of the rejected portion; but I may now inquire in which part of the animal, during the above process, does the mechanical operation take place that Mr. Lewes states is the only one by which the food is prepared for assimilation? It cannot be in the cavity of the body, for that is fully and rigidly distended with water whilst the food is within it; so that no pressure from mutual contact of the membranous septa can be exerted to extract the juices of the meat. The only time when such an agency can be employed is during the first passage of the food through the stomach, or subsequently on its return. In either case, the operation would only last for a very few minutes; and undoubtedly some pressure *may* be exercised during the process of regurgitation, as the rejected food must find its way upwards from the large gastric cavity into the free open extremity of the membranous stomach—a proceeding very much like that of getting out of a flexible lobster-pot: the contortions the polype sometimes makes whilst this is going on show the difficulty it labours under; however, it is soon over, and the morsel is ejected,—but in what condition? Is it in a state that can be accounted for by mechanical action only?

It may be here mentioned that I have various species of *Actiniæ* that have been in my possession for periods ranging from six months to as many years; and as they are generally fed once a week, and for the most part on partially cooked beef, frequent opportunities are afforded me for observing the results of feeding these animals on substantial food.

I find, then, that the remains of the meat are returned in one of three conditions, viz.:

1. Unaltered in shape, the muscular fibre intact, but with the appearance of having undergone simple maceration in sea-water, and enlarged rather than contracted in size.

2. In a rounded mass, reduced in size, not only from being rolled into a ball, but also in consequence of a partial solution of its substance; the muscular striæ faintly visible.

3. In the form of minute particles, whose aggregate bulk frequently does not equal one-fiftieth part of the original piece.

Some of these particles, when submitted to a magnifying power of 450 diameters, occasionally exhibit definite structure; but usually they are all homogeneous in their composition, and show *no trace of muscular striæ or distinct fibre.*

In the first two cases the remains are enveloped in a tenacious glairy mucus, proving them to have been ejected from the polype; in the third condition this evidence is not so decided. However, in order to avoid any possibility of mistake as to the origin of these particles, separate *Actiniæ* were placed in small glass vases, each containing only clean water and a stone bearing the single polype: the results of feeding them under these circumstances agreed with what were before observed; and when the meat was returned in the *first* condition, it was found lying on the stone or bottom of the glass; when in the *second* form, it was most frequently floating at the surface of the water; and if in the *third* and disintegrated state, it was always in that position, and immediately over the polype, unless intercepted and entangled in the mucous epidermis, as sometimes happens in the case of *Act. mesembryanthemum.*

Now let me ask, can we entirely account for these effects by the simple act of squeezing, or any other mechanical operation that can go on within the soft body of the polype? It appears to me impossible. But strong as the evidence is of the action of some solvent when only small disintegrated particles are returned, my latest experiments are still more conclusive of its existence. Of six *Actiniæ* that were fed from the same bit of meat, two threw up a few very small particles; the others, after an interval of more than a week, returned absolutely *nothing* that could be detected with the aid of a lens. These four polypes are two varieties of *Sagartia troglodytes,* a *S. nivea* and a *S. viduata*—all of them voracious species; the others are *S. venusta* and *Act. mesembryanthemum.*

No mechanical power will account for these results; and for their explanation I can only have recourse to the alternative, chemical agency, which Mr. Lewes selects as "the specific characteristic of the digestive process," but whose existence he denies in the *Actiniæ.* Of the origin and nature of the solvent I can say nothing; but I would direct attention to the glairy mucus so abundantly produced in the stomach of the polype when its surface is irritated by the presence of food. Possibly this may act only in a preparatory manner; but that it is concerned in the alimentary process there can be no question, as it is specially called forth under the excitement of feeding. This mucus appears to be a product of the stomach, since it is found coating the food before it has descended into the cavity of the body, as may be proved by giving a polype a piece of meat too large to

be entirely swallowed: on its disengagement from the animal, that portion of it which had passed the mouth will be seen thickly covered with the secretion. One frequent source of error in studying the digestive powers of the *Actiniæ* arises from the belief that all the food these animals swallow must necessarily undergo digestion, whatever the nature of that process may be; but this is far from being the case. Healthy polypes will rarely refuse anything that comes within their reach; and in most cases it is only after the object has passed through the stomach, that the animal finds out whether it is hungry, or if it has swallowed suitable food. In my own tank, a specific-gravity bubble has been gulped down by almost every specimen large enough to accomplish the feat, and by some of them more than once; but of course it is always ejected unaltered: in the same manner, proper food has been taken in and returned after a short time only, not from its being indigestible, but because the animal was not hungry. In our own case, over-eating is generally followed by indigestion; but the polype has a very ready mode of preventing such an unpleasant result. When its appetite is appeased, or its powers of digestion exhausted, it simply throws up what remains of the food; and this circumstance will explain the different states of the ejected meat, and the reason why large pieces are so often cast forth with little apparent alteration. A case has recently presented itself which shows this to be a reasonable inference. Two specimens of *Cerianthus*, which had been living side by side for a couple of years in a tall glass jar, were fed with small and equal portions of beef, and after a time each animal threw up the remains of its dinner. In one case, where the polype had been fasting for a week, the food was returned after twelve hours very little altered in shape; muscular striæ were perceptible under the microscope, and the general appearance of the meat indicated its having undergone maceration, but not compression. In the other example the refuse was cast up, after an interval of sixteen hours, in very small particles without any trace of muscular structure, and so far disintegrated as to render their removal from the water a matter of some difficulty. This polype had not been fed for six weeks; and the different results from the two animals may be fairly accounted for by the unequal intervals between their last two meals. In the true *Actiniæ* there is the same variation in the extent to which digestion is carried as in the instances just cited, and in a great measure it will bear the same explanation: we also find it partly depending on the digestible nature of the food swallowed. In the account of Mr. R. Q. Couch's experiments, quoted in 'Seaside Studies,' p. 217, great stress is laid on the fact that the delicate

skin of the ventral portions of the mackerel and whiting was uninjured, and the fine metallic lustre untouched: but I should think it is hardly necessary to remind Mr. Lewes that, in the most highly organized animals, portions of food difficult of digestion are frequently unchanged when passed off in the excretions; so that the circumstance referred to can have no bearing on the question of ordinary digestive power.

The experiments on the food contained in perforated quills also appear to me to be by no means so conclusive of the absence of chemical action as Mr. Lewes thinks; they rather favour the suggestion I have thrown out as to the nature of the mucus produced in the stomach. From the tenacious character of this substance, it would pass through the perforations in the quill far less readily than would the surrounding water, and consequently the appearance of meat freely subjected to its influence might reasonably be expected to differ from that of the partially protected contents of the quill. Such, indeed, appears to have been the case in Mr. Lewes's experiment. We are told at page 216, "On examination of the ejected quills, I found no appreciable difference between the contained meat and similar pieces of meat left in the water during the same period: in one of them, which had the meat protruding somewhat from each end of the quill, there was a maceration of the protruded ends which looked like a digestive effect;" but this effect, the author goes on to say, was due to "maceration obviously of a purely mechanical nature," because the muscular fibre was not disintegrated. Why *obviously mechanical*? After what I have observed of the partial and sometimes entire solution and disintegration of the food, may I not as reasonably ascribe "what looked like a digestive effect" to the *obvious commencement of chemical action*?

I have now mentioned some of the facts which lead me to believe in the possession of ordinary digestive power by the Actiniadæ. The cases I have noticed as bearing on the subject are but a few out of many similar ones that have occurred to me and, unquestionably, to other persons who have given their attention to the matter; for I cannot believe that when a Sea-anemone becomes an occupant of my aquarium, it is thenceforth gifted with new faculties, and learns to digest its food in a manner unknown to its brethren in other tanks or along the coast.

There are some other points relating to the *Actiniæ*, which are treated of in 'Seaside Studies,' and on which the author holds opinions at variance with those of most naturalists; but it must be observed that in almost every case he only brings forward negative evidence in support of his views; and I need hardly say that, in matters of science, such evidence is not always trustworthy.

The question of the existence of a corpusculated fluid in the *Actiniæ* need hardly be discussed. The corpuscles have been too frequently observed to leave room for any doubt of their existence. I have never failed in discovering them when I have used a power of 450 diameters; and when the fluid was taken from the body of a polype placed during three days in well-filtered sea-water, the result was only in a slight degree less decisive—the corpuscles were not quite so abundant.

At present I can say but little on the albuminous character of the chylaqueous fluid. Experiments on the subject can be satisfactorily carried on only at the sea-side, where there are plenty of healthy polypes to cut up without running the risk of destroying old favourites. On the single occasion when I boiled some quantity of the fluid, milkiness was produced; but at a later period, when small drops taken from other animals were tested with nitric acid, I could not be sure that a change of colour took place in every case. The experiments were made on animals that had been kept both in natural and filtered sea-water; but testing the character of a minute drop of fluid is an operation so delicate and novel to me, that I hesitate to give an opinion from the results I then obtained.

It must be regretted that Mr. Lewes is so positive in his conclusions from what certainly look like hasty experiments; and in questioning their soundness I am justified by the author himself when he tells us, at p. 261, "We see the necessity of a cultivated caution in the acceptance of statements in matters so complex as those of biology."

I remain, Gentlemen,
Yours very truly,
E. W. H. Holdsworth.

26 Osnaburgh Street, Sept. 1859.

XXX.—*Description of several Species of Entomostracous Crustacea from Jerusalem.* By W. Baird, M.D., F.L.S.

[With two Plates.]

In the month of July 1858, Edward Atkinson, Esq., a gentleman attached as surgeon to the consulate at Jerusalem, and who has resided in that city for some time, sent a quantity of dried mud from the pool of Gihon in Jerusalem to Mr. Denny at Leeds. By the kindness of this latter gentleman, I had a supply of this forwarded to me, which Mr. Denny states had been in all probability in a dry state for some months before it was despatched. It reached Leeds in the end of August, and the small parcel containing a supply reached me at the

British Museum on the 3rd of June, 1859. Mr. Atkinson, in a letter, informed Mr. Denny that if this mud were placed in fresh water, it would soon produce a crop of Entomostraca. This had accordingly been done at Leeds; and the result was as predicted. Placing the portion of mud which Mr. Denny had kindly sent me to the British Museum in water on the 3rd of June last, I was agreeably surprised to find several young animals of the class Entomostraca make their appearance seven days afterwards, or on the 10th of the same month. These I watched till they had assumed a sufficient degree of development, and I then discovered that they were the young of a species of *Estheria*. Shortly after this, fresh forms made their appearance; and by the middle of July I found I had a large crop of Entomostracous Crustacea, consisting of at least five different species. These I consider to be distinct from any yet described, and, both from their peculiar history and characters, worthy of a detailed description.

In addition to the species here described, Mr. Denny had the kindness to forward me a pair of a species of *Chirocephalus*, male and female, but which unfortunately died before I was able to secure them for description. They were of a pale whitish colour, and considerably smaller than the species found in Great Britain.

Estheria Gihoni. Pl. V. fig. 1.

Carapace oval, rather flat and compressed. Umbo rather prominent, and placed near the anterior extremity. Surface of shell encircled with prominent ribs, the intervening spaces being rather broad, slightly convex and irregularly excavately punctate. Anterior extremity slightly broader than the posterior. Dorsal margin, from the umbo to the posterior slope, nearly straight, the posterior half sloping downwards. Anterior and ventral margins rounded.

The body of the animal is of a beautiful red colour. The male is larger than the female, and the prehensile feet are rather large, and are furnished with strong hooks.

The head is large, and the sort of hood with which it terminates is long and rather sharp-pointed.

Hab. Pool of Gihon, Jerusalem. Mus. Brit.

Daphnia Atkinsoni. Pl. V. fig. 2.

Female. Carapace of an oval form; lower extremity pointed and terminating in a rather long spine, which is beset on all sides with short spines. Anterior margins of the valves armed with short setæ, which spring from the inner edge.

The head is rather large and prominent; beak of considerable

size. The superior antennæ, underneath the beak, are rounded, of considerable size, and terminated by four or five short setæ. The inferior antennæ have the basal portion stout and thick; the joints are all rough with minute spines; filaments plumose. In the number of joints and filaments it agrees with *D. pulex*. The surface of the carapace is rough with minute spines, and is finely reticulated; it is of a very light colour. The eye is large, and the black spot near the beak is very distinct, almost as much as that of the *Lynceidæ*. The abdomen is narrow, the lower edge armed with a row of short spines, and the terminating spines rather strong and hooked. The sixth segment of the body has three spurs or projections, the upper one of which is curved upwards, the lower sending off two rather long setæ, which are plumose only on the lower half of their length.

I have only seen females.

Hab. Pool of Gihon, Jerusalem.

Approaches very near *D. pulex*. Ephippia, from which these young most probably spring, are different in shape, being longer, narrower, and sharp-pointed.

Cypris celtica. Pl. VI. fig. 1.

Carapace wedge-shaped, like the most usual form of the stone implements known by the name of *celts*. Anterior extremity considerably broader than the posterior, and compressed. Posterior extremity pointed and compressed also. Dorsal margin rounded, convex. Ventral margin nearly straight, or very slightly sinuated. Surface of carapace very smooth and shining, destitute of all appearance of hairs or pubescence. The interior of the valves, owing to the compression of the two extremities, hollow in the centre only; each valve, for a short distance at each extremity, lying upon the other so as to fill up the hollow, and limit the space allowed for the animal, to about the centre.

Pediform antennæ furnished with a rather long pencil of plumose filaments. The colour of the shell is a light olive-green, with a lighter streak running diagonally across the posterior part of the carapace.

This species resembles somewhat the British species *C. clavata* in the shape of the carapace, but is shorter, has no hairs or setæ on its surface, and has larger pediform antennæ and feet.

Hab. Pool of Gihon, Jerusalem. Mus. Brit.

Cypris orientalis. Pl. VI. fig. 2.

Carapace of nearly a reniform shape; dorsal margin convexly rounded; ventral margin rather deeply sinuated. Anterior extremity slightly compressed. Posterior extremity nearly of the

same size as the anterior, but swollen and sloping downwards to an obtuse point. Centre of carapace swollen. The surface of the valves is hispid all over with short stiff setæ, which beset the edges round the whole circumference. When rubbed off, they leave the appearance of little pits or depressions.

Pediform antennæ provided with a pencil of rather long plumose filaments.

The colour of the shell is of a very light olive-greenish hue. The ova appear shining through the carapace like two orange spots.

Hab. Pool of Gihon, Jerusalem. Mus. Brit.

Diaptomus similis. Pl. VI. fig. 3.

In the general form of the body, the number of articulations, &c., it agrees with *D. Castor*. The head, however, is curved downwards into a short curved beak. The antennæ are furnished on the upper edge with short setæ at each joint; but these setæ are set at right angles with the joint, and are nearly alternately short and long, the longer ones being nearly double the length of the shorter ones. The third pair of foot-jaws have the same number of articulations as those of *D. Castor*, but the setæ at the terminating joints are much shorter and slightly aculeate. The fifth pair of feet in the male have the last articulation of the right branch terminated by a long and strong hook, which is much longer than that of *D. Castor*. The swollen hinge-joint of the right antenna of the male, when under the lens, is finely striated.

Hab. Pool of Gihon, Jerusalem. Mus. Brit.

EXPLANATION OF PLATES.

Plate V.

Fig. 1. *Estheria Gihoni*, nat. size: 1 *a*, magnified; 1 *b*, portion of carapace, magnified; 1 *c*, terminating hooks of abdomen; 1 *d*, prehensile feet of male.

Fig. 2. *Daphnia Atkinsoni*, magnified, side view: 2 *a*, Ditto, prone; 2 *c*, portion of carapace highly magnified, to show the structure.

Plate VI.

Fig. 1. *Cypris celtica*, magnified: 1 *a*, *b*, Ditto, in different positions; 1 *c*, portion of carapace, highly magnified to show the structure; 1 *d*, lucid spots; 1 *e*, pediform antennæ.

Fig. 2. *Cypris orientalis*, magnified: 2 *a*, *b*, Ditto, in different positions; 2 *c*, lucid spots; 2 *d*, structure of carapace; 2 *e*, pediform antennæ.

Fig. 3. *Diaptomus similis*, magnified: 3 *a*, terminating setæ of tail.

XXXI.—*Centuries of North American Fungi.* By the Rev. M. J. Berkeley, M.A., F.L.S., and the Rev. M. A. Curtis, D.D.

[Continued from ser. 2. vol. xii. p. 435.]

**Agaricus* (Amanita) *cæsareus*, Schæff. South Carolina, H. W. Ravenel.

51. *A.* (Amanita) *Ravenelii*, B. & C. Pileo convexo areolato-verrucoso, verrucis pyramidatis; stipite brevi bulboso; volva crassa verrucosa sublobata; annulo deflexo. *Amanita bulbosa*, Rav. In woods, June, Car. Inf., H. W. Ravenel.

Pileus 4 inches across, convex, broken up into distinct areæ, each of which is raised into an acute rigid pyramidal wart; stem 3 inches high, 1 inch or more in thickness at the base, furnished with a thick warty volva and a deflexed ring.

A very fine species, allied to *A. strobiliformis*, Vitt.

52. *A.* (Lepiota) *subremotus*, B. & C. Pileo expanso obtuse umbonato toto verrucoso-squamoso, margine sulcato; stipite floccoso-farcto e bulbo æqualiter attenuato debili lævi; annulo amplo secedente; lamellis subangustis remotiusculis. Curt. no. 5067. On the ground amongst fir-leaves, New England, C. J. Sprague.

White. Pileus 4 inches across, expanded, obtusely umbonate, fleshy, except at the margin, which is in consequence sulcate, covered to the top of the umbo with raised wartlike scales; stem 5 inches high, clavato-bulbous at the base, attenuated upwards, $\frac{1}{3}$ inch thick in the centre, smooth, stuffed with floccose threads, rather delicate; ring uneven, broad; gills white, rather narrow, free, but not separated far from the stem.

This species is undoubtedly very near *A. mastoideus*; but the stem is not sunk into the umbo, as in that species, and in consequence the gills are not very remote.

53. *A.* (Tricholoma) *rhinarius*, B. & C. Pileo convexo, obtusissimo, centro subtiliter areolato-diffracto; margine squamuloso; stipite valido furfuraceo; lamellis ex albo flavis confertis emarginatis. Curt. no. 5745. In dense patches amongst dry leaves in woods, New England, C. J. Sprague.

Pileus 5 inches across, convex, very obtuse, yellowish white at the margin and minutely scaly, then ochraceous and yellow brown in the centre, where it is broken up into little brown scale-like areolæ; surface rimose; margin at first involute, then 3–4 inches high, 1 inch or more thick, solid, yellowish, furfuraceous from the curling up of minute portions of the cuticle; gills at first white, then yellow, crowded, adnate, emarginate, more or less forked.

Allied to *A. scalpturatus*.

54. *A.* (Clitocybe) *porphyrellus*, B. & C. Pileo convexo glabro

purpurascente; stipite solido sursum incrassato glabro albopurpureo; lamellis rectis adnatis pallide purpureis. Curt. no. 5520. On the naked soil, Connecticut, C. Wright.

Pileus 1½ inch across, convex, smooth, of a pale dull purple; stem 1–1½ inch high, 1½ line thick, solid, smooth, incrassated upwards, purplish white; gills pale purple, margin straight. Spores elliptic, $\frac{1}{3750}$ inch long.

Differs from *A. laccatus* in the numerous gills and very different spores.

55. *A.* (Clitocybe) *glaucipes*, B. & C. Pileo convexo tenui rufulo pubescente, margine incurvo; stipite solido concolore glauco; lamellis adnatis distantibus rectis candidis. Curt. no. 5546. On the ground in woods, Connecticut, C. Wright.

Pileus 1 inch across, convex, thin, pubescent, pale rufous; margin incurved; stem 2 inches high, ¼ inch thick, solid, of the same colour as the pileus, with a white bloom; gills moderately distant, adnate, straight, white.

Allied to *A. laccatus.*

56. *A.* (Collybia) *præceps*, B. & C. Pileo e convexo umbilicato virgato rufo; stipite deorsum attenuato, pruinoso; lamellis albidis adnatis. Curt. no. 5758. New England, Aug. 1856, D. Murray.

Pileus 2–4 inches or more across, subcarnose, at first convex, then flat and depressed, undulated, russet-brown, darker in the centre, finely and regularly streaked; flesh white, soft; stem 3–4 inches high, about ¼ inch thick, strongly attenuated at the base, rather twisted, flexible, stringy with a loose pith; gills dirty white, thickish, somewhat ventricose, acutely adnate; edges at length uneven and the surface wrinkled, sometimes streaked with brown.

A flexible, top-heavy, flabby species, allied to *A. fusipes.*

57. *A.* (Collybia) *Spraguei*, B. & C. Albus, pileo umbonato carnoso sericeo-nitente stipiteque cavo glabris; lamellis angustis adnatis crispatis. Curt. no. 5757. On decayed stumps in shady woods, Sept. 1856, New England, Sprague.

White. Pileus 4–5 inches across, convex, strongly umbonate, fleshy, smooth, with a satiny lustre when dry; flesh very thick in the centre, not very compact; margin thin, slightly turned up; stem 4½–5 inches high, 1 inch thick, smooth, stringy, very hollow, splitting and bending with the weight of the pileus; gills narrow, obtusely adnate, crowded, crisped; edge minutely waved.

A moist heavy-topped species, allied to *A. maculatus.*

58. *A.* (Collybia) *stereocephalus*, B. & C. Pileo convexo, late umbonato firmo brunneo-albo; stipite farcto candido basi bulboso; lamellis albis adnatis utrinque rotundatis. Curt. no.

5744. On the ground amongst fir-leaves in wet woods, Sept. 1856, C. J. Sprague.

Pileus 2 inches across, convex, very broadly umbonate, fleshy, at length flat, smooth, brownish drab or white; flesh white, very firm and hard; stem 3 inches high, ½ inch thick, bulbous at the base, stuffed with satiny fibres, externally fibroso-cartilaginous, twisted, flexuous, white; gills white, ventricose, moderately broad, obtuse in front, rounded behind and adnate, crowded.

Allied to *A. maculatus*.

59. *A.* (Collybia) *luteo-olivaceus*, B. & C. Parvus, luteo-olivaceus; pileo convexo-umbilicato glabro tenui; stipite leviter fistuloso, subtiliter furfuraceo flexuoso; lamellis adnatis. Curt. no. 5728. On old stumps in wet woods, Aug. 1856, C. J. Sprague.

Pileus ½ an inch across, convex, slightly umbilicate, thin, smooth, opake when wet, shining when dry, olive-yellow; stem 1½ inch long, 1 line thick, flexuous, minutely fistulose and scurfy, of a dirty ochre; gills crowded, adnate, of the same colour as the pileus, moderately broad. Spores white, subelliptic.

Evidently allied to *A. trochilus*.

60. *A.* (Collybia) *semihærens*, B. & C. Pileo convexo rufo glabro; stipite gracili solido fusco, sursum pallido pubescente; lamellis distantibus ex albido luteo-fuscis adnexis. Curt. no. 5528. On dead sticks amongst grass in woods, Connecticut, C. Wright.

Pileus ⅛–¼ inch across, convex, smooth, rufous, darker with age; stem 2 inches high, not a line thick, dark brown, pale and thicker above, clothed all over with short soft hairs; gills whitish, changing to pale yellowish brown, distant, adnexed, moderately broad; interstices veiny.

A very beautiful species.

61. *A.* (Mycena) *intertextus*, B. & C. Densissime cæspitosus; pileo hemisphærico, umbonato, demum expanso striato; stipitibus villo connatis, subfragilibus; lamellis distantibus, crassiusculis, adnatis. Curt. nos. 1741, 2557, 2558. On pine, South Carolina, M. A. Curtis.

Pileus 3–8 lines across, carnoso-membranaceous, convex, umbonate, then expanded, pellucid, fusco-cinereous, margin paler, striate; stems 2 inches high, ⅛ a line thick, fistulose, smooth above and fuscous, pale below and joined intimately together by matted down; gills white, thick, adnate.

A very beautiful and singular species.

62. *A.* (Mycena) *connatipes*, B. & C. Dense cæspitosus; pileo hemisphærico alutaceo; stipitibus albis basi connatis; lamellis albido-flavis denti adnatis. Curt. no. 512. On the ground in dense clusters, Upper Carolina, M. A. Curtis.

Pileus 2–8 lines across, hemispherical, buff; stems 2 inches long, 1½ line thick, white, confluent at the base and rooting; gills whitish yellow, adnate, subdecurrent.

Allied to *A. proliferus*, from which it differs in its hemispherical pileus, adnato-decurrent gills, &c.

63. *A.* (Omphalia) *xanthophyllus*, B. & C. Pileo depresso rubro-purpureo, floccoso, margine striato; stipite flavo-albo glabro subcompresso fistuloso deorsum attenuato subbulboso; lamellis flavis decurrentibus. Curt. no. 2871. On the sides of damp putrid logs, Aug., South Carolina, M. A. Curtis.

Pileus 2–3 inches across, depressed, floccose, red-purple; margin inflexed, somewhat striate; stem 3–4 inches long, ¼–⅓ inch thick, yellowish white, smooth, more or less compressed, fistulose, tapering downwards, but bulbous at the base; gills yellow, decurrent.

A very fine species, allied to *A. chrysophyllus*. There are two other new allied species, which, however, we cannot describe for want of sufficient materials.

63*. *A.* (Pleurotus) *pulvinatus*, P. Curt. no. 5896. On an apple tree, Nov., New England, C. J. Sprague.

Pileus 3½ inches across, very excentric, pulvinate, wrinkled and irregularly tessellated, of a dirty reddish-yellow white; flesh firm, white, 1 inch thick; margin undulated, abruptly incurved; stem extremely short, thick, solid and fleshy; gills narrow, yellowish white, decurrent or much attenuated, rather distant.

As this appears to be the plant of Persoon, which is little known, we have given a description drawn up from Sprague's copious notes, which are accompanied by an excellent sketch. Smell like that of fresh potatoes, or somewhat acid and fruity, so strong as to scent the whole room.

64. *A.* (Pleurotus) *barbatulus*, B. & C. Pileo postice adnato hispidulo, margine inflexo glabro; lamellis distantibus tenuibus, interstitiis lævibus. Curt. no. 6890. On dead sticks, Boston, D. Murray.

Somewhat imbricated. Pileus ½ an inch across, adnate behind, convex in front, rough, except towards the inflexed margin, with short downy hairs; stem none, gills distant, thin; edge sometimes slightly toothed; interstices even, pulverulent in the young plant.

Allied to *A. atrocæruleus*. When dry, it is of a pale ochre, but is probably pearly white when fresh. We have the same species from Cuba, attaining an inch or more in diameter.

65. *A.* (Pleurotus) *semicaptus*, B. & C. Pileo e resupinato breviter reflexo irregulari albido pulverulento; margine crenato; lamellis angustis distantibus integris concoloribus. Curt. no. 5362. On dead branches of birch, New England, C. J. Sprague.

Gregarious; pileus at first resupinate, then reflexed, about $\frac{1}{4}$ inch across, irregular, narrow, dirty white, pulverulent, with a little thin film extending on the matrix from the resupinate portion; margin waved or crenate; gills narrow, entire, distant, of the same colour as the pileus. Spores cymbiform, white, $\frac{1}{4000}$ inch long.

A very curious and distinct species. Occasionally the white film extends over the whole matrix.

66. *A.* (Pleurotus) *Blakeii*, B. & C. Pileo reniformi, conchato, rufo, glabro, postice puberulo; lamellis latis ventricosis tenuibus subconcoloribus, interstitiis venosis: Curt. no. 6289. On dead fir, Maine, Rev. J. Blake.

Pileus $\frac{1}{2}$ an inch across, reniform, conchate, quite smooth, of a deep red brown, obscurely downy behind; margin incurved; gills paler than the pileus, broad, ventricose, thin, distant; interstices veiny; stem none.

67. *A.* (Pleurotus) *candidissimus*, B. & C. Niveus; pileo reniformi, l. dimidiato, glabro, villo parco affixo, margine sulcato; lamellis distantibus, interstitiis lævibus. Curt. no. 6191. Maine, C. J. Sprague.

Pileus $\frac{1}{4}$ inch across, reniform or dimidiate, stemless, pure white, opake, smooth, like kid-leather; margin sulcate; gills white, slightly ventricose, attenuated behind, moderately broad, distant; interstices even.

A very beautiful and delicate species.

68. *A.* (Pleurotus) *racodium*, B. & C. Pileo griseo, conchato, atro-strigoso; lamellis griseis. Curt. no. 4058. On rotten wood, Pennsylvania, Dr. Michener.

Pileus $\frac{1}{4}$ inch across, conchiform, grey, clothed behind with dense black bristle-like hairs; margin striate; gills of the same colour as the pileus, moderately distant.

Closely allied to *A. applicatus*, but distinguished by the dense black hairs, which make it look, when dry, like a *Sphæria*.

69. *A.* (Volvaria) *emendatior*, B. & C. Pileo plano umbonato glabro; stipite sursum deorsumque incrassato, volva marginata; lamellis remotis. Curt. nos. 5074, 2546. On rich garden soil, New England, C. J. Sprague; Lower Carolina, M. A. Curtis.

Pileus 3 inches across, flat, with an obtuse umbo, smooth, white; margin thin, striate; stem 3 inches high, $\frac{1}{4}$ inch thick, slightly incrassated above and below, very slightly arachnoideo-fibrous, solid; volva forming merely a short rim; gills ventricose, remote, free and rounded behind, white, at length flesh-coloured, extending in front beyond the rugged margin of the pileus, as in *Montagnites*. Spores broadly cymbiform, $\frac{1}{3000}$ inch long. Smell disagreeable, but not strong. In the button state the pileus is areolate.

70. *A.* (Pluteus) *chrysophlebius*, B. & Rav. Pileo convexo flavo reticulato-rugoso; stipite gracili basi hirsuto sub-bulboso; lamellis latis remotis ex albo carneis. On putrid hickory logs, September, South Carolina, H. W. Ravenel.

Pileus ½ an inch across, convex, yellow, with darker reticulated veins radiating from the centre; stem 1–2 inches high, not 1 line thick, enlarged above, slightly bulbous, white and hirsute at the base; gills broad, remote, white, then flesh-coloured.

An exquisite species, allied to *A. phlebophorus*, from which it differs in habit and in colour.

71. *A.* (Entoloma) *Murraii*, B. & C. Stramineus, pileo tenui striato glabro; stipite gracili; lamellis latis distantibus adnexis. Curt. no. 5800. In wet grounds, New England, D. Murray.

Straw-yellow. Pileus 1 inch across, convex, changing to a rich red brown when dry, regularly striate; margin crenulate; stem 2 inches high, 1 line thick; gills broad, distant, attenuated behind and adnexed; interstices veined. Spores irregular, $\frac{1}{2500}$ inch long.

An extremely pretty species.

72. *A.* (Clitopilus) *abortivus*, B. & C. Pileo e convexo plano, depresse-tomentoso griseo; stipite subæquali subtiliter flocoso albido; lamellis decurrentibus carneis. Curt. no. 5737. In damp wood, Sept., C. J. Sprague.

Pileus 2 inches or more across, at first convex, then plane, clothed with close felted pubescence of a clear light grey, smoother in age; flesh compact; margin incurved; stem 3 inches high, ¼ inch thick, minutely downy, especially below, often tufted and connate, nearly white, solid, with a loose shining pith; gills strongly decurrent, crowded, thin, pale flesh-coloured, becoming deeper in age. Spores irregular, not elongated and even, as in *A. prunulus*, $\frac{1}{5000}$ inch long. Often abortive, and then presenting subglobose umbilicate downy masses.

Closely allied to *A. popinalis*, which is also frequently abortive, but distinguished by its downy pileus and the gills not being grey. The stem also appears to be firmer.

73. *A.* (Clitopilus) *melilotus*, B. & C. Graveolens; pileo convexo centro depresso glabro; stipite subæquali striato, fibrilloso; lamellis latis decurrentibus. Curt. no. 5798. On the ground, New England, D. Murray.

Pileus 2 inches across, convex, depressed in the centre, smooth; margin incurved; stem 2½ inches high, ⅓ inch thick, striate, fibrillose; gills broad, thin, decurrent; spores irregular, $\frac{1}{5000}$ inch across.

This is evidently a very well-marked species, distinguished by its strong scent of melilot when dry. We are able at present

to characterize it very imperfectly, but it is too marked to be omitted entirely.

74. *A.* (Leptonia) *assularum*, B. & C. Pileo e campanulato explanato, umbonato glabro virgato albido; stipite fuligineo; lamellis ex albo carneis secedentibus. Curt. no. 2842. On rotten bits of wood in swamps, Sept., South Carolina, M. A. Curtis.

Pileus 1½ inch across, campanulate, then expanded, umbonate, smooth, virgate, whitish with the centre dark; margin striate; flesh thin, stem nearly 3 inches high, 1½ line thick, fuliginous, flexuous, nearly equal; gills white, at length flesh-coloured, subventricose. Spores irregular.

Evidently distinct from the other white-gilled *Leptoniæ* which grow on wood.

75. *A.* (Leptonia) *variicolor*, B. & C. Pileo umbilicato glabro pallide fusco; stipite farcto; lamellis postice abrupte attenuatis adnatis purpureo-albis. Curt. no. 5530. Amongst bushes in damp ground, Connecticut, C. Wright.

Pileus ½–1½ inch broad, umbilicate, smooth, pale brown; flesh thin; stem 2 inches high, 1½ line thick, greenish blue, smooth, stuffed with woolly fibres; gills broad, distant, somewhat ventricose, abruptly attenuated behind, and adnate, pale purplish white. Spores irregular, $\frac{1}{3000}$ inch in diameter.

Allied to *A. asprellus.*

76. *A.* (Nolanea) *quadratus*, B. & C. Pileo membranaceo conico demum reflexo aurantiaco-fusco; stipite fistuloso aurantiaco-luteo; lamellis carneo-aurantiacis latis ventricosis. Curt. no. 5735. Amongst wet mosses in pine swamps, New England, C. J. Sprague.

Pileus 1½ inch across, membranaceous, at first obtusely conical, then depressed, striate, of a clear orange or brown orange; stem 3 inches high, tender, fistulose to the very top of the pileus, orange-yellow; gills very broad, ventricose, almost triangular, at first adnexed, then decurrent as the pileus becomes depressed, of a beautiful incarnate orange; spores, when seen from above, quadrangular, $\frac{1}{1750}$ inch across, sometimes irregular.

One of the most splendid and singular species of the genus.

77. *A.* (Eccilia) *pyrinus*, B. & C. Graveolens; pileo umbilicato fusco; stipite compresso fistuloso; lamellis albidis. Curt. no. 5066. In swampy ground, New England, C. J. Sprague.

Pileus 1 inch across, at first broadly convex, then flat, umbilicate, dark brown in the centre, grey at the crenate edge; stem 1½ inch high, ⅛–¼ inch thick, hollow, at length compressed; gills whitish, slightly decurrent; spores irregular, angular. Odour like that of ripe pears.

78. *A.* (Naucoria) *siparioïdes*, B. & C. Pileo hemisphærico

flavo-fusco subtiliter squamulato-verrucoso; stipite fistuloso fibrilloso fusco, basi flavo-tomentoso; lamellis latis secedentibus distantibus. Curt. no. 5051. On the mud of an exsiccated swamp, New England, C. J. Sprague.

Pileus $\frac{1}{2}$–$\frac{3}{4}$ inch across, hemispherical, yellow-brown, minutely and thickly squamulato-verrucose; flesh thin, brittle; stem 1 inch high, not 1 line thick, fistulose, brown, fibrillose at the base, abruptly swollen, and covered with a dull pale-yellowish down; gills plane, distant, attached, but soon free, and with their edge denticulate; spores subelliptic, $\frac{1}{4000}$ inch long.

This is undoubtedly close to *A. siparius*, which sometimes grows in the same kind of locality; but in that species the spores are $\frac{1}{2500}$ inch long, not to mention other points.

79. *A.* (Naucoria) *pennsylvanicus*, B. & C. Pileo e conico umbilicato subcarnoso squamuloso; stipite fibrilloso-furfuraceo; lamellis latiusculis denticulatis adnexis subdistantibus. Curt. nos. 3954, 3956. Amongst fragments of wood, Pennsylvania, Dr. Michener.

Pileus about 1 inch broad, at first conical, obtuse, then expanded and umbilicate, tawny, clothed with minute, erect, sometimes wart-like scales; stem 1 inch high, 1 line thick, hollow, clothed with furfuraceous fibrils; gills rather broad, distant, brown, edged with white denticulations; spores subelliptic, $\frac{1}{2750}$–$\frac{1}{3000}$ inch long.

The spores are much smaller than in *A. conspersus*, with which it agrees in many respects.

80. *A.* (Crepidotus) *malachius*, B. & C. Sparsus; pileo cuneiformi subflabellato albo molli; stipite brevissimo, albo tomentoso; lamellis ventricosis confertis ex albo flavidis. Curt. no. 5730. On the sides of old stumps in wet woods, New England, Aug., C. J. Sprague.

Gregarious, but scattered, horizontal; pileus 1–2 inches across, smooth, white, cuneiform, subflabellate; flesh rather thick behind, very thin in front; stem 1–2 lines long, white, tomentose; gills at first white, then yellow-brown, ventricose, obtuse behind, thin, crowded. Spores nearly globose, $\frac{1}{4500}$ inch in diameter.

This species resembles *A. nephrodes* in the kid-like pileus, but the gills and spores are very different.

81. *A.* (Crepidotus) *pecten*, B. & C. Pusillus; pileo pectiniformi crenato-sulcato tomentoso e resupinato reflexo; lamellis latiusculis umbrinis. Curt. no. 4991. On dead branches, Upper Carolina, M. A. Curtis.

Pileus 2 lines across, ochraceous, flabellate, strongly sulcate and crenate, tomentose, attached by a little white down; stem none; gills moderately broad, umber; margin fringed with

minute clavate hairs; spores subelliptic, pale ochre, $\frac{1}{3000}$–$\frac{1}{3500}$ inch long.

Looks at first like a minute *Schizophyllum*.

82. *A.* (Crepidotus) *putrigena*, B. & C. Imbricatus; pileo subreniformi, albido tomentoso; margine striato; lamellis ex albido ferrugineis. Curt. no. 2566. On damp rotten logs, Dec., Santee Canal, South Carolina, H. W. Ravenel.

Densely imbricated; pileus $\frac{1}{2}$–$\frac{3}{4}$ inch or more across, subreniform, dirty white, tomentose, clothed with thicker white down at the point of attachment; margin slightly striate; stem none; gills broad, at first dirty white, then ferruginous from the spores; spores nearly globose, $\frac{1}{3500}$ inch in diameter.

This is at once distinguished, without other marks, by the subglobose spores resembling those of *A. malachius* and *nephrodes*.

If this is the same as an Agaric sent me by Mr. Ravenel, which agrees in the spores, it attains much larger dimensions.

83. *Coprinus Spraguеii*, B. & C. Tenerrimus; pileo e campanulato conico tomentoso plicato; stipite fistuloso pallide cinnamomeo; lamellis paucis angustis. Curt. no. 5303. In wet springy ground, New England, C. J. Sprague.

Pileus $\frac{3}{4}$ inch across, at first campanulate, then conical, pale brown, darker in the centre, downy, plicate, interstices pale; stem 2 inches high, 1 line thick, pale cinnamon, fistulose; gills few, narrow, tender, brown; spores subcymbiform, $\frac{1}{2500}$ inch long.

This is clearly different from *C. plicatilis*; and the difference is confirmed by the spores being narrower and smaller. The same species, apparently, occurs in Pennsylvania and Upper Carolina (4289 & 485).

84. *C. Wrightii*, B. & C. Pileo ex ovali plano striato glauco furfuraceo; stipite fistuloso glabro; lamellis liberis cinereis. Curt. no. 5534. On little bits of grass, &c., in flower-pots, Connecticut, C. Wright.

Pileus $\frac{1}{4}$–$\frac{1}{2}$ inch broad, at first oval, then flat and expanded, radiato-striate, of a glaucous grey, with small brown chaffy specks; stem 2 inches high, not $\frac{1}{2}$ a line thick, whitish, smooth, pellucid, fistulose, attached by a little down at the base; gills moderately distant, narrow, free, dark grey; spores subcymbiform, $\frac{1}{2500}$ inch long.

A minute but distinct species.

85. *Hygrophorus cærulescens*, B. & C. Pileo plano subumbonato viscido cæruleo-alutaceo; stipite glabro pallide cæruleo; lamellis distantibus crassis decurrentibus pileo obscurioribus. Curt. no. 5434. In woods, amongst dead leaves and sticks, which adhere to it, New England, C. J. Sprague.

Pileus 2 inches across, nearly flat, thick and obtuse in the centre, viscid when moist, shining with a satiny lustre when dry, of a delicate blue-drab; stem 2½ inches high, ⅓ inch thick, attenuated downwards, smooth, pale blue, at first firm, then soft and hollow; gills few, rather thick and fleshy, decurrent, darker than the pileus; interstices corrugated.

A very beautiful species.

86. *H. aurantiaco-luteus*, B. & C. Pusillus, aurantiacus; pileo e convexo subumbilicato striato glabro; stipite gracili; lamellis arcuatis decurrentibus. Curt. no. 5571. Amongst moss (*Dicranum*), Connecticut, C. Wright.

Gregarious, deep orange. Pileus ¼ inch across, at first convex, then flat or somewhat depressed, smooth, striate; stem 1½ inch high, not 1 line thick, attenuated downwards, smooth; gills arched, strongly decurrent.

This species has precisely the habit of *Agaricus fibula.*

87. *Lactarius hygrophoroides*, B. & C. Pusillus; pileo sicco pulverulento stipiteque brevi flavo-rubris; lamellis decurrentibus, distantibus, luteis; interstitiis rugosis. Curt. no. 6194. On the ground, Aug., Maine, C. J. Sprague.

Pileus 1½ inch across, convex, at length plane, pulverulent, yellowish red; stem not 1 inch high, ⅓ inch thick, of the same colour as the pileus; gills very distant, decurrent, yellowish; interstices rugose.

This species has somewhat the habit of *L. volemum.*

**L. calceolus*, B. Two forms of this curious species occur in New England, a larger and a smaller.

88. *L. subtomentosus*, B. & Rav. Pileo subtomentoso compacto stipiteque cavo basi albo-umbrinis; lamellis latis distantibus decurrentibus albidis; lacte ex albo flavescente acrido. On the ground in swamps, South Carolina, Sept., H. W. Ravenel.

Pileus 2–3 inches across, convex, umber-brown, dry, subtomentose, firm; stem 1 inch high, ½ inch thick, of the same colour as the pileus, except at the base, where it is white, hollow; gills distant, broad, decurrent; milk-white, becoming yellowish, acrid.

Allied to *Lactarius fuliginosus.*

89. *Cantharellus princeps*, B. & C. Maximus, aurantiacus; pileo infundibuliformi-rugoso, stipite deorsum attenuato; plicis reticulatis. Curt. no. 6196. Maine, C. J. Sprague.

Orange. Pileus 5 inches or more across, deeply infundibuliform, rugose; stem 5½ inches high, 1 inch thick, attenuated downwards; folds forming an open network.

This is the largest of the genus, and most distinct. Unfortunately we cannot give a more perfect description, as we have no notes.

90. *C. Petersii*, B. & C. Pusillus; pileo depresso subzonato stipiteque gracili dealbatis; plicis distantibus decurrentibus; interstitiis venosis. Curt. no. 6077. Amongst moss at the base of trees, Alabama, Hon. J. M. Peters.

Pileus 1 inch across, depressed, white, opake, with one or two concentric furrows; stem 1 inch high, 1 line thick, white like the pileus; folds moderately broad, distant, decurrent; interstices wrinkled.

Resembling somewhat the white variety of *C. aurantiacus*, but a smaller plant, with broader folds.

91. *C. lignatilis*, B. & C. Rufus; pileo tenui infundibuliformi striato glabro; stipite subæquali plicis tenuibus decurrentibus. Curt. no. 1979. On rotten logs, South Carolina, H. W. Ravenel.

Reddish brown; pileus 2 inches across, smooth, infundibuliform, deeply striate; stem 2 inches or more high, $\frac{1}{4}$–$\frac{1}{3}$ inch thick, smooth; folds thin, decurrent.

Of this we have no notes; but the peculiar habitat and characters will distinguish it.

92. *C. Wrightii*, B. & C. Pileo plano demum depresso, pallide rubro; stipite solido striato rufescente sursum incrassato; plicis demum decurrentibus glauco-rubris; interstitiis venosis. Curt. no. 5559. On the ground in the shade of trees, Connecticut, C. Wright.

Pileus $\frac{1}{2}$–$1\frac{1}{2}$ inch across, plane, at length depressed, dull red, edge irregularly deflexed; stem $1\frac{1}{2}$ inch high, 2 lines thick, solid, striate, somewhat fibrous, brownish red, incrassated upwards; folds at first free, at length decurrent, waved, of a pale glaucous red; interstices veined; spores fusiform, with the endochrome retracted to either extremity, $\frac{1}{2250}$ inch long.

Analogous to *Agaricus laccatus*.

93. *Marasmius velutipes*, B. & C. Pileo umbilicato tenui striato ochraceo-fusco, l. fusco; stipite striato velutino pallido, l. basi ferrugineo; lamellis angustis confertis adnexis. Curt. no. 2548. On leaves in dried swamps, Aug., M. A. Curtis.

Pileus $\frac{1}{2}$–$\frac{3}{4}$ inch across, ochraceous, brown or dark brown, thin, dry, striate, umbilicate: stem $1\frac{1}{2}$–2 inches high, 1 line thick, straight, clothed with pale velvety down, sometimes a little tawny below, hollow; gills narrow, crowded, pale, slightly adnate.

Differing materially from *M. archyropus* in the nature of the clothing of the stem, and from *M. spongiosus* in the more crowded narrow gills and umbilicate pileus.

94. *M. Olneii*, B. & C. Pileo convexo glabro rufescente striato; stipite albo subtiliter pulverulento-tomentoso insititio; lamellis liberis collariatis albis. Curt. no. 1821. On dead twigs, Rhode Island, Olney.

Pileus $\frac{1}{3}$ inch across, convex, smooth, striate, pale rufous; stem $1\frac{1}{2}$ inch high, not a line thick, white, minutely pulverulent-tomentose, especially below; gills white, distant, minutely toothed, free, forming by their junction a little collar round the top of the stem.

95. *M. viticola*, B. & C. Pileo depresso subcoriaceo tenui sulcato striato rufo; stipite brevi insititio fusco pruinoso, furfuraceo; lamellis pallidis distantibus; interstitiis lævibus. Curt. no. 4604. On dead vine branches, Alabama, Hon. J. M. Peters.

Pileus $\frac{3}{4}$ of an inch broad, dry, subcoriaceous, depressed, sulcato-striate, pale rufous; stem 1 inch high, dark brown, pulverulent; gills distant, pale, slightly adnate, moderately broad, ventricose; interstices even.

The stems are sometimes confluent.

96. *M. pruinatus*, B. & C. Pileo campanulato sulcato pruinato rugoso; stipite setiformi nitido cinereo; lamellis paucis, interstitiis lævibus. Curt. no. 5064. On little bits of grass, &c., New England, C. J. Sprague.

Pileus $\frac{1}{2}$ an inch across, campanulate, pale umber, pruinose, minutely wrinkled; stem 2 inches high, setiform, pale cinereous or tinged with reddish brown, shining with a satiny lustre; gills ochraceous, few, distant, interstices even. A thin white mycelium like a corticium spreads over the matrix.

97. *Heliomyces decolorans*, B. & C. Albus, exsiccatione rufus; pileo glabro rugoso sulcato; stipite rigido nitido; lamellis latis decurrentibus. Curt. no. 6079. On dead wood, Alabama, Hon. J. M. Peters.

Pileus 1 inch or more across, white at first as well as the gills, but changing in drying to a deep tawny brown, smooth, wrinkled, sulcate; stem 2 inches high, shining, more permanent in colour, but sometimes becoming rufous; gills broad, distant, decurrent; interstices wrinkled.

The change of colour is exactly that which takes place in *Hygrophorus eburneus.*

98. *Paxillus rudis*, B. & C. Pileo subcuneiformi sordide flavido tomentoso, margine inflexo; stipite nullo; lamellis crassiusculis obtusis postice costatis. Curt. no. 5521. On pine timber of a railroad embankment, growing horizontally in the crevices between the timbers, Connecticut, C. Wright.

Pileus 2 inches or more across, tomentose, dirty yellow brown, wedge-shaped when growing freely, but often attached behind with a narrow reflected margin, which is strongly incurved; stem none; gills rather thick, obtuse, costate behind, ferruginous, not reticulate; spores dirty yellow, subelliptic, with a large globose nucleus and hyaline gelatinous coat, $\frac{1}{1000}$ inch long.

Undoubtedly allied to *Paxillus panuoides*, but at once distinguished by the peculiar spores.

99. *Panus strigosus*, B. & C. Maximus; pileo excentrico depresso stipiteque valido strigosis; lamellis latis distantibus decurrentibus. Curt. nos. 6197, 5170. On oak stumps, New England, C. J. Sprague; Pennsylvania, Dr. Michener.

White; pileus 8 inches across, excentric, clothed with coarse strigose pubescence; margin thin; stem 2–3 inches high, 1 inch or more thick, strigose like the pileus; gills broad, distant, decurrent.

Allied to *Panus levis*.

100. *Panus operculatus*, B. & C. Fasciculato-erumpens; pileo cupulæformi apice affixo rufo furfuraceo-villoso glabrescente; lamellis angustis tenuibus primum velo operculatis. Curt. no. 5697. On bark, New England, D. Murray.

Fasciculate, erumpent; pileus cup-shaped, ½ an inch or more across, fixed by the apex, rufous, clothed with scurfy pubescence, which at length vanishes; gills narrow, of the same colour as the pileus, at first covered by a tympanoid veil.

Allied to *P. Delastrii*, Mont.

XXXII.—*Notice of a new Antelope* (Kobus) *from Central Africa*. By John Edward Gray, F.R.S.

The British Museum has lately received, through Mr. Samuel Stevens, a number of heads and horns of Antelopes, &c., from Awan Bahr il Gazal (lat. 6° 70′ N.), in Central Africa, which have been brought to England by Mr. Petherick, who has been in the country collecting ivory, &c. I will first give a list of the animals brought, to show their geographical range, and then proceed to give a short notice of the new species.

1. *Bos Taurus*, Gray, Cat. of Ungulata in Coll. B. M. p. 17. Variety with the horns elongate and subspiral. Nader-Sobat, lat. 11° N.

2. *Bubalus Caffer*, Gray, Cat. p. 28. Horns.

3. *Adenota Lechèe*, Gray, Cat. p. 98. Male skin, in a bad state; skull of half-grown male and female. Awan and Raik.

4. *Kobus Maria*, n. s. Two heads, male and female. Awan.

5. *Kobus ellipsiprymnus*, p. 99. Head of male and female. Raik.

6. *Alcelaphus Bubalis*, p. 123. Several heads, of both sexes. Djour.

7. *Damalis Senegalensis*, p. 126. Head of male and females. Azack.

8. *Tragelaphus sylvatica*, p. 139. Head of male.

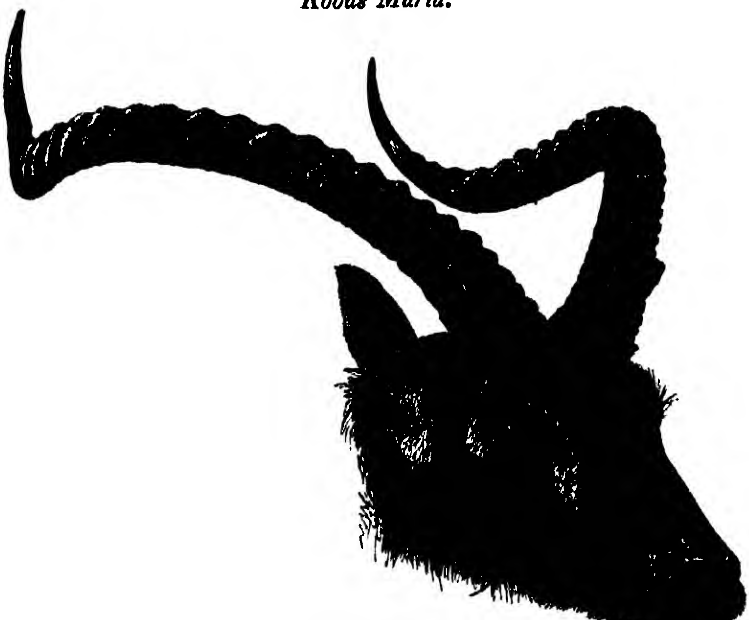
9. *Giraffa Camelopardalis*, p. 181. Head of male; pale variety.

10. *Rhinoceros bicornis.* Skull, with horns of a large size; half-grown.

11. *Hippopotamus amphibius.* Skull. From Senaar, lat. 12° 18′.

I propose to name the new species, after my wife, who has so assisted me in my studies,

Kobus Maria.



Head of Male.

Head of *male* blackish-brown; lips, chin, gullet, orbits and temple enclosing the base of the ears, and the ears, whitish; the sides of the nose brownish; the hair of the cheek, side of the lower jaw, gullet, and upper part (all that remains) of the neck elongate, rigid; the horns elongate, rather slender, widely lyrate, with very strong transverse ridges and incurved tips.

Head of *female* brown, with the chin and gullet, base of the ears, and two small spots (one over the front and the other behind the lower edge of the eye) whitish; the hair of the head black, with brown tips; of the lower part of the cheek, lower jaw, and neck very long. Hornless.

BIBLIOGRAPHICAL NOTICES.

Reports of Explorations and Surveys to ascertain the most practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean, made under the Direction of the Secretary of War in 1853–6. Vol. x. Washington, 1859. 4to.

We have already on two occasions noticed the work of which the present volume forms a part, as containing large and valuable contributions towards our knowledge of the Fauna and Flora of North America, and we have explained the circumstances which led to its production. The 10th volume, which has now been received, contains the 3rd and 4th Parts of the General Report upon the Zoology, and the separate Reports of several of the different Expeditions upon the same subject. Of the General Report upon the Reptiles of North America we are forced to content ourselves with the plates only, the War Department having "considered it advisable to omit the publication" of this portion of the work on account of "the General Natural History Reports having been extended so much beyond the limits originally contemplated." We do not thank the War Office for this. After bearing the burden of the nine thick quarto volumes already issued, it was hardly worth while to kick at the few sheets of letter-press necessary for the General Report on Reptiles, for which the plates had been already prepared. We fear, after all, that the Government at Washington have not quite liberated themselves from the penny-wise and pound-foolish system which prevails in relation to scientific undertakings on this side of the Atlantic. However, the plates, of themselves, will be of great assistance to those who are attempting to follow Messrs. Baird and Girard into the numerous new genera and species which they have created amongst the American animals of this class, and may, we hope, convince European naturalists of the validity of these new subdivisions, concerning which at present they seem to be rather incredulous*.

The General Report on the Fishes collected by the Expeditions, of which the War Department have favoured us with the letter-press as well as the plates, next follows. It is from the pen of Dr. Charles Girard, and, in our opinion, contrasts rather unfavourably with those upon the Mammals and Birds, already issued. The subdivision of genera is here carried to an almost incredible extent; the numerous supposed new species are but shortly and imperfectly characterized; and the whole execution, particularly from the misprints being glaring and numerous, bears evident marks of haste. For all that, such a general *résumé* of the present state of our knowledge of this class of animals, as found in the North American continent, cannot be otherwise than an important work, and one that the ichthyologists of Europe will do well to make themselves well acquainted with.

* See 'Catalogue of Colubrine Snakes in the Collection of the British Museum,' by Dr. A. Günther (London, 1858), and the same author's remarks in Proc. Zool. Soc. 1858, p. 385.

The remainder of the volume is occupied by the special Zoological Reports of some of the separate Expeditions sent out to survey the Pacific Railroad routes,—namely, of those under the commands of Lieutenants Beckwith, Whipple, Parke, Williamson, and Abbott. It would have been better, we think, to have merged all these Reports into the General Report, and to have issued the whole in one connected series. It is tiresome to be referred from the Special Report to the General for the description of a species or the characters of a genus, and from the General to the Special for remarks on the habits of animals, their mode of propagation, &c. But it is easy to criticize; and all the points to which we have alluded detract but little from the great general value of this work. We fear it will be long before our own Government issues a series of "Blue-books" so generally acceptable to the scientific world, or so likely to escape the usual fate of the British article—being sold for waste paper.

Animal Physiology. By William B. Carpenter, M.D., F.R.S., F.G.S., F.L.S. New edition, thoroughly revised and partly re-written. Sm. 8vo. London, H. G. Bohn, 1859.

Of the series of scientific manuals prepared many years ago by Dr. Carpenter, and published by W. S. Orr and Co. of Amen Corner, the treatise on Animal Physiology was certainly one of the best. It has already passed through two or three editions; and we have now to announce the publication of a new edition thoroughly revised by the author.

The book has undergone considerable alterations in many parts, in order to bring it up to the present state of science; and three chapters especially have been almost entirely re-written. These are: the first chapter, treating "of the vital operations of animals, and the instruments by which they are performed," which contains an excellent digest of the distinctive characters of animals, with an account of the nature of their various tissues and the chemical constituents of the latter; the second chapter, giving a general view of the classification of the animal kingdom, which is greatly improved; and the last chapter, which treats of the phænomena of reproduction. The changes in the latter are very extensive, as may be supposed from the great progress made within the last few years in our knowledge of these matters; and the reader will find in it a very good, although succinct account, not only of the ordinary development of the ovum, but also of the alternation of generations, and of the singular phænomena to which Siebold restricts the term Parthenogenesis. On the whole, we may safely recommend the present edition of Dr. Carpenter's little book as the best popular account of the structure and functions of the animal body for the use of the general reader.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

[Received May 30, 1859.]

"On the frequent Occurrence of Vegetable Parasites in the Hard Structures of Animals." By Professor A. Kölliker, of Würzburg.

As far as I am aware, Quekett was the first to point out that vegetable parasites, viz. *Confervæ*, occur frequently in the skeleton of Corals (Lectures on Histology, vol. ii. p. 153. fig. 78. and p. 276); but although he mentions in the same place that the *tubuli* described by Carpenter in the shells of Bivalves have also a great resemblance to *Confervæ*, he did not venture any further step, and he adheres to the view of Carpenter, who regards them as a typical structure. Some years later, Rose ("On Parasitic Borings in Fossil Fish-Scales," Transactions of the Microscopical Society of London, vol. x. p. 7, 1855) discovered a peculiar tubular structure in fossil fish-scales, which he regarded as being occasioned by parasites, and possibly by Infusoria, but he was not able to give any good proof of this hypothesis. The same must be said of E. Claparède (Müll. Archiv, 1857, p. 119), who found similar canals in the shell of *Neritina fluviatilis*, and showed that they do not really belong to the shell—without being happier in determining the nature of the parasite, only suggesting that it might possibly be a sponge.

Such was the state of things, when Prof. Wedl of Vienna and myself, independently of each other, took up the question. The observations of Wedl, which concern only the parasites of the shells of Bivalves and Gasteropods, were communicated to the Vienna Academy on the 14th of October, 1858, and are therefore previous to my own, which were presented to our Würzburg Society on the 14th of May, 1859; but I received Wedl's memoir only on the 16th of May, and may therefore say that my observations, which, besides, are extended over many more groups of animals, were quite independent of those of the Austrian microscopist. This being the case, it may be regarded as a good proof of the correctness of our observations and the truth of our conclusions, that we agree in the principal facts, there being only this discrepancy between us, that Wedl calls the parasites *Confervæ*, whilst I regard them as *Unicellular Fungi*. The botanists will decide this question better than we; only I beg leave to say that all the numerous parasites observed by myself were *unicellular*, and that the *sporangia* were quite of the same kind as those of unicellular fungi. I may further add that the frequent anastomoses of the parasitic tubes remind one of the anastomoses observed in the mycelium of some unicellular fungi, whereas such connexions have not yet, so far as I know, been observed amongst the *Confervæ*.

I now give a short enumeration of the animals in whose skeleton I observed these vegetable parasites.

1. *Spongiæ.*

Two undetermined species of sponges, which I obtained through the kindness of Mr. Bowerbank, show a great many parasitical tubes in the horny fibres of their skeleton. These are most elegant and numerous in one species from Australia, in which the tubes form a superficial network in the outermost parts of the horny sponge-fibres and straighter canals in their interior, and possess a great many round *sporangia*, which in some cases even showed young outgrowths in the form of short ramifying tubes.

2. *Foraminifera.*

In an extensive collection of sections of Foraminifera which I owe to the kindness of my friend Prof. Carpenter, there were many genera which showed numerous filaments of fungi in their shell itself, viz. *Polystomella*, *Orbitolina*, *Heterostegina*, *Amphistegina*, *Calcarina*, *Alveolina*, and *Operculina*. The last genus shows best that these parasitic tubes, which sometimes are very large, are quite different from the two kinds of tubes rightly described by Carpenter as belonging to the shell itself. They generally run at right angles to the finer tubuli, and are easily distinguished from both kinds of typical tubuli by their irregular course, and by their frequent branching, and even anastomosing. They are absent in many specimens of the above-named genera, and could not be found in *Cycloclypeus*, *Nummulina*, and *Nonionina*.

3. *Corals.*

All the genera of Corals which I investigated contained parasitical fungi, viz. *Astræa diffusa*, *Porites clavaria*, *Tubipora musica*, *Corallium rubrum*, *Oculina diffusa*, *Oculina*, sp., *Alloporina mirabilis*, *Madrepora cornuta*, *Lobalia prolifera*, *Millepora alcicornis*, *Fungia*, sp. The fungi were most frequent in the genera *Tubipora*, *Astræa*, *Porites*, and *Oculina*, the last three of which contained also many *sporangia*, which in the red coral were very scarce and often wanting.

4. *Bivalves.*

I agree with Wedl that the tubuli described by Carpenter in the shells of Bivalves are all parasites. Many of them agree in every respect with those found in other hard structures of the Invertebrata, of whose parasitical nature there can be no doubt; and even possess *sporangia*, as those of *Thracia*, *Lima*, *Cleidothærus*, *Anomia*, *Ostrea*, *Meleagrina*. With respect to those of the genera *Lithodomus*, *Arca*, *Pectunculus*, *Nucula*, *Cardium*, it is true that their straight course and more regular distribution speak in favour of their typical occurrence; but as in some cases true parasites also are very regularly distributed through the shells, there can be no doubt that even these do not really belong to the structure of the shells.

5. *Brachiopods.*

The test of some *Terebratulæ* shows, besides the large well-known canals, minute tubuli running straight through the fibres. A vertical

section of *Terebratula australis*, which I got from Prof. Carpenter, showed that the minute canals referred to belong to a vegetable parasite of the same kind as those of the Bivalves.

6. *Gasteropods.*

Nearly all examined Gasteropods, viz. *Cerithium tuberculatum*, *Aporrhais pes-Pelecani*, *Turbo rugosus*, *Murex brandaris*, *Murex trunculus*, *Haliotis*, *Vermetus*, *Trochus*, *Littorina littorea*, *Terebra myurus*, *Tritonium cretaceum*, contained vegetable parasites in their shells; and in some these were as numerous as in the Bivalves, and showed also *sporangia*. Besides these fungi, the shell of *Trochus* also contained in its most superficial layers unicellular pyriform algæ with green contents.

7. *Annelids.*

Even in this group the unicellular parasites were found, viz. in the calcareous tubes of two *Serpulæ* from the Scotch coast.

8. *Cirrhipeds.*

The same parasites also occurred very numerously in the shells of a large *Balanus*. On the other hand, the genera *Diadema* and *Lepas* were free from them; and with regard to the straight tubes of *Pollicipes* described by Quekett, which also occur in *Tubicinella*, I am inclined to reckon them amongst the typical structures.

9. *Fishes.*

The scales of *Beryx ornatus*, from the clay, contain very numerous and pretty parasitic structures, which almost exactly agree with those figured by Rose in his fig. 5. They undoubtedly also belong to the simplest form of fungi, but are of greater interest, inasmuch as they are fossil and seem to constitute a new genus. I was not able to find parasites in any other fish-scales, notwithstanding that I examined scales of all living and many fossil species of Ganoids and many *Teleostei*.

These are the facts which I have been able to gather, up to this time. I have no doubt that all will ageee with me in regarding this question as one of great interest for the zoologist as well as for the botanist. The former will now be obliged to study these parasitical structures as thoroughly as possible, in order to decide which tubular structures of the hard tissues of animals are typical and which are not; and for the botanist a new field of investigation is opened, which not only draws attention by the somewhat strange forms offered for investigation, but is also of great interest in a physiological point of view. It seems to me probable that the parasites dissolve the carbonate of lime of the hard structures into which they penetrate, by means of an exudation of carbonic acid, which secretion would seem to take place only at the growing ends of the fungial tubes, as they never lie in larger cavities, but are always closely surrounded by the calcareous mass. In some cases, as in the horny fibres of sponges, it seems probable that the parasites simply bore their canals by

mechanical force, as is the case when vegetable parasites make their way through the cell-membranes of *Confervæ* or other plants. Besides this, it deserves also to be remembered that nearly all the parasites here spoken of occur in marine animals.

In concluding this notice, I may further mention that these parasites afford an excellent means for demonstrating the *double-refracting power* of the shells of the several genera mentioned in this communication. I was first struck with this fact in examining a horizontal section of *Lima scabra* obtained from Dr. Carpenter, and finding that many tubuli appeared double. In following this matter, it was easy to show that all the tubuli running in a certain direction, and in an oblique way through the section, appeared simple at the upper surface of it, and became double in the inferior layers, so that the distance of the two images increased with the shortening of the focus. When the preparation was inverted, the reverse was the case. The same phenomena as in *Lima* were also observed in *Anomia*, *Ostrea*, *Murex truncatus*, *Turbo rugosus*, *Tritonium cretaceum*, and *Balanus*, the shells of which animals have therefore all such a structure that they refract the light in the same way as the well-known double-refracting crystals*.

ZOOLOGICAL SOCIETY.

January 11, 1859.—Dr. Gray, F.R.S., V.P., in the Chair.

Notes on the "Mooruk" (Casuarius Bennettii). By George Bennett.

On the 26th of October 1858, the 'Oberon' cutter of forty-eight tons arrived in Sydney, having two fine young specimens of the "Mooruk" on board, stated to be male and female. On going on board I found them confined in a very small space; and the Captain informed me he had had them eight months, that he procured them soon after his arrival at New Britain for Sydney, and since that time had been trading about the islands, having these birds on board; they were fed principally upon yams. I observed they were in poor condition, but healthy in appearance, and plumage in good order. They were about half the size of the specimen sent to England; but one, apparently the male bird, appeared a little larger than the other. Captain Devlin informs me that the natives capture them very young, soon after they are hatched, and rear them by hand. The natives rarely or never can capture the adult bird, as they are so very shy and difficult of approach—the native weapons being ineffectual against so rapid and wary a bird. These birds are very swift of foot, and possess great strength in the legs; on the

* According to Brewster (Bibl. Univ. de Genève, 1836, ii. 182), who seems the only person who has hitherto observed the double-refracting power of a shell, viz. of the mother-of-pearl, that shell (*Meleagrina*) shows the same phenomena as the double-axed double-refracting Arragonite,—on which question I am not as yet able to give an opinion.

least alarm they elevate the head, and, seeing danger, dart among the thick brush, and thread about in localities where no human being could follow them, and disappear like magic. This bird, with its strong legs and muscular thighs, has an extraordinary power of leaping: it was from this circumstance the first bird brought from New Britain was lost: from its habit of leaping, it one day made a spring on the deck and went overboard; as it was blowing a strong breeze at the time, the bird perished. In warm weather, the Captain informs me, they are fond of having a bucket of salt water thrown over them, and seem to enjoy it very much. I succeeded in purchasing these birds; and Captain Slater (the present commander of the 'Oberon') brought them to my house in a cab; and when placed in the yard, they walked about as tame as turkeys. They approached any one that came into the yard, pecking the hand as if desirous of being fed, and were very docile. They began by pecking at a bone in the yard, probably not having tasted any meat for some time, and would not, while engaged upon it, touch some boiled potatoes which were thrown to them; indeed we found afterwards they fed better out of a dish than from the ground—no doubt, having been accustomed early to be fed in that manner. They were as familiar as if born and bred among us for years, and did not require time to reconcile them to their new situation, but became sociable and quite at home at once. We found them next day rather too tame, or, like spoilt pets, too often in the way. One or both of them would walk into the kitchen; while one was dodging under the tables and chairs, the other would leap upon the table, keeping the cook in a state of excitement; or they would be heard chirping in the hall, or walk into the library in search of food or information, or walk up stairs, and then be quickly seen descending again, making their peculiar chirping, whistling noise; not a door could be left open, but in they walked, familiar with all. They kept the servants constantly on the alert: if the servant went to open the door, on turning round she found a "Mooruk" behind her; for they seldom went together, generally wandering apart from each other. If any attempt was made to turn them out by force, they would dart rapidly round the room, dodging about under the tables, chairs, and sofas, and then end by squatting down under a sofa or in a corner; and it was impossible to remove the bird, except by carrying it away: on attempting this, the long, powerful, muscular legs would begin kicking and struggling, and soon get released, when it would politely walk out of its own accord. I found the best method was to entice them out, as if you had something eatable in the hand, when they would follow the direction in which you wished to lead them. They sometimes also give a smart kick to any person attempting to turn them out forcibly. The housemaid attempting to turn the bird out of one of the rooms, it gave her a kick and tore her dress whilst she was very politely driving him before her. They walk into the stable among the horses, poking their bills into the manger. When writing in my study, a chirping, whistling noise is heard; the door, which was ajar, is pushed open; and in walk the "Mooruks," who quietly pace round the room, in-

specting everything, and then as peaceably go out again. If any attempt is made to turn them out, they leap and dodge about, and exhibit a wonderful rapidity of movement, which no one would suppose possible from their quiet gait and manner at other times. Even in the very tame state of these birds, I have seen sufficient of them to know that, if they were loose in a wood, it would be impossible to catch them, and almost as difficult to shoot them. One day, when apparently frightened at something that occurred, I saw one of them scour round the yard at a swift pace, and speedily disappear under the archway so rapidly that the eye could hardly follow it, upsetting all the poultry in its progress, as they could not get out of the way. The lower half of the stable-door, about 4 feet high, was kept shut to prevent them going in; but this proved no obstacle, as it was easily leaped over by these birds. They never appeared to take any notice of, or be frightened at, the Jabiru or Gigantic Crane, which was in the same yard, although that sedate, stately bird was not pleased at their intrusion. One day I remarked the Jabiru spreading his long wings, and clattering his beak, opposite one of the "Mooruks," as if in ridicule of their wingless condition. "Mooruk," on the other hand, was pruning its feathers and spreading out its funny little apology for wings, as if proud of displaying the stiff horny shafts with which they were adorned. The "Mooruks" often throw up all their feathers, ruffling them; and then they suddenly fall flat as before: they appear to have great power in raising all the feathers; and the wings are used to aid them in running, but never seem used for defence. Captain Devlin says, the natives consider them to a certain degree sacred, and rear them as pets; he is not aware that they are used as food, but if so, not generally; indeed their shy disposition and power of rapid running, darting through the brake and bush, would almost preclude their capture. It reminds me (from the description) of the habits of the *Menura*, or Lyre-bird of Australia; only it is much larger and more powerful in its actions. The natives carry them in their arms, and are very kind to and have a great affection for them; this will account for their domesticated state with us.

The noise of these birds, when in the yard, resembled that of the female Turkey; at other times the peculiar chirping noise was accompanied by a whistling sound also. The contrast of these birds with the Jabiru was very great. The "Mooruks" were sometimes moving about like the female Turkey in rapid motion or excitement, or, when walking quietly, always inquisitive and poking their beaks into everything and familiar with every person. The Jabiru, on the other hand, was a perfect picture of sedate quietness, looking upon all play as injurious to his constitution or derogatory to his dignity, remaining stiff in his gait and serious in his demeanour.

Only one egg was brought, and that was partly broken; I have it in my possession. The Captain informs me that they can be procured from the natives, and have generally a hole in them about the size of a shilling, through which the contents have been extracted.

The height of the largest or male bird, to the top of the back, wa

2 feet 2 inches, and of the female 2 feet. The height of the largest or male bird, when erect, to the top of the head, was 3 feet 2 inches, and of the female 3 feet.

Description of the Adult State of Voluta mamilla, Gray. By Dr. J. E. Gray, F.R.S., V.P.Z.S., etc.

We have had in the British Museum for years a young specimen of a shell from Van Diemen's Land, which I named *Voluta mamilla*. It is figured under that name in Sowerby's 'Conchological Thesaurus,' t. 50. f. 57, 58; it is described by me in my "Observations on the Species of Volutes," Proc. Zool. Soc. 1855, p. 55, under the name of *Scapha mamilla*; and it is noticed under the genus *Cymbium* by the Messrs. A. and H. Adams, in their 'Genera of Mollusca.'

But many conchologists have been inclined to regard this specimen as a mere monstrosity of some other species,—an idea that could only have been entertained by such as were ignorant of the general structure and physiology of molluscous animals.

We have lately received from Van Diemen's Land three fine specimens of this shell,—two of them fully grown, and the other intermediate in size between the young specimen we formerly possessed and the adult state of the species. It may be observed that these shells were all taken while the animals were growing; the shells have consequently the thin edge incident to that state of the animal, and not the rounded thickened edge to the outer lip which the shell assumes while it is in a state of rest after its former growths. Though probably the full size of the species, they are none of them what conchologists generally call adult shells. But this form of the outer lip is no proof of the adult state of the shell; for the animal constantly increases the size of the shell after such thickening and periods of rest; thus the thickening of the edge of the lip is only a proof that the shell was taken and the animal destroyed while the animal and shell were not increasing their size.

The adult shell greatly resembles *Scapha magnifica* in form and colouring; but the apex is much larger, irregular, with the apex of the whorl on one side of the tip; and the system of colouring is much broader, and coarser in its character.

Scapha mamilla.

Shell ovate; nucleus very large, spire rather irregular, one-coloured, orange, with the apex on one side; the last whorl irregularly markled with dark purple-brown lines having triangular pale spots, and with a subcentral and broad posterior sutural colourless band. Pillar dark orange, with three oblique plaits. Throat yellow.

This form of the nucleus is found in another species of the genus *Scapha*, but not in such a highly developed state, viz. in *Scapha fusiformis*, also inhabiting Van Diemen's Land; and it is also found in the genus *Fulgoraria*.

Several conchologists, for example the Messrs. Adams, have supposed that this shell, on account of the size of the nucleus, ought to be referred to the genus *Cymbium*, which is characterized by having an irregular callous tip to the nucleus; but if the nucleus of *V. mamilla* is properly examined, it will be found that it is distinctly spiral, but has the apex of the first whorl of the nucleus excentric or bent on one side; and this is not very uncommon in several species of *Chrysostoma* and *Fusus*, &c.

The species of *Scapha* may be thus divided, according to the form and surface of the whole of the nucleus:—

I. *Spire of nucleus regular, with a central apex.*

a. *Nucleus large; whorls crenulated near the suture.*

S. vespertilio.
S. nivosa.
S. Sophia.
S. rutila.
S. magnifica.

b. *Nucleus large; whorls smooth.*

S. aulica.
S. Deshayesii.
S. leucostoma.

c. *Nucleus moderate or small; spire often subcylindrical, generally truncated or deciduous.*

S. punctata.
S. colocyntha.
S. magellanica.
S. javanica.
S. Ferussacii.
S. pacifica.
S. concinna.

II. *Spire of nucleus rather irregular; the apex excentric, lateral.*

S. fusiformis, apex moderate.
S. mamilla, apex very large.

Notice of Notopteris, a new Genus of Pteropine Bat from the Feejee Islands. By Dr. J. E. Gray, F.R.S., etc.

Among a large collection of the skins of Mammalia, Birds, Fishes, Crustacea, &c., sent to the British Museum by the Lords of the Admiralty, which were collected by Mr. Rayner, Dr. Macdonald, and the Medical Officers of H.M. Ship 'Herald,' during the voyage to the Feejee and other Pacific Islands, under the direction of Captain Denman, R.N., there are two specimens of a small Pteropine Bat from the island of Viti, which has the elongated face and the general appearance of the *Kiodote* (*Macroglossus*), but is provided with an elongated, free, slender, tapering tail, nearly as long as the hind legs, which, like the tail of most Bats having this member enclosed in the interfemoral membrane, is arched, the tip being bent ventrally or downwards.

Considering that the best genera of Bats are those established on the external conformation of the members, I am inclined to propose for this animal a new generic designation; and I have no doubt that,

when its habits and manners are known, they will be found to differ considerably from those of *Macroglossus* and *Cephalotes*, to which it is most nearly allied.

NOTOPTERIS.

Head elongate; muzzle produced, subcylindrical; nose simple, muffle narrow, bald between the nostrils, with a deep central notch. Ears small, lateral. Body covered with rather crisp hair. Wings broad, short, arising from the middle of the back, bald, only separated by a very narrow line of hair down the vertebral line, and with soft hair on the under side near the body. Thumb elongate; lower joint half the length of the upper, and enclosed in a web. The index-finger, of three bony joints; the last joint short, clawless. Interfemoral membrane deeply cut out, fringing the hind legs to the heel, hairy above and on the under side near the body, bald at other parts. Tail elongate, slender, tapering, many-jointed, arising from, and with the base attached to, the under side of the narrow interfemoral membrane; as long as the hind legs. The skull elongate, produced and slender in front.

Cutting teeth $\frac{1-1}{1-1}$; canines $\frac{1-1}{1-1}$; grinders $\frac{4-4}{5-5}$.

The cutting teeth conical, far apart; the upper are very small, rudimentary, on the middle of the intermaxillary bone between the end of the nose and the canine teeth; the lower rather larger, conical, blunt, separated from each other by a broad lunate space near the front edge of the canine teeth; canine larger, grooved; grinders compressed, blunt.

The upper cutting teeth are conical, small, far apart, placed on the middle of the slender produced intermaxillary bones, which have a small depression near the anterior extremity, like a cavity, whence a second chisel-shaped tooth might be developed; but as there is no appearance of the tooth in either of the skulls, perhaps it may be where a tooth of this kind has been shed.

The lower teeth are small and blunt, placed near the front of the base of the canine tooth. The edge of the front of the jaw between these teeth is rather produced and sharp-edged, and is nicked near the cutting tooth, giving the jaw somewhat the appearance of a second tooth, but it is not enamelled.

The canines elongate, conical, acute, curved.

The grinders are reniform, compressed, gradually diminishing in size towards the back of the jaws; the front one on each side in each jaw is largest, higher than the rest, and crenated on the crown; the rest have a flat smooth crown.

The tongue was not preserved; but, from the form of the muzzle and of the cutting teeth, I think it is very probably elongate, like that of the genus *Macroglossus*.

In the absence of the claw on the index-finger, this animal agrees with the genus *Cephalotes* from Timor, as it also does with the account of the wings and the teeth given in the systematic works; but it differs from that genus very essentially when the specimens

of the two animals are compared. The head of *Cephalotes* is much shorter and broader. The cutting teeth are exceedingly different: in *Cephalotes* the cutting teeth are close together, the upper ones chisel-shaped, the lower ones rather conical, entirely filling up the very narrow space between the base of the large canines; while in *Notopteris* they are only two, far apart, small and isolated.

The wings of the two genera arise from the centre of the back; and the bases of the wings, which cover the back, are naked. But in *Cephalotes* the nakedness extends over the shoulders to a line even with the front edge of the wings; in *Notopteris* the naked part only occupies the hinder half of the back or loins, the shoulders being exposed and covered with hair like the rest of the body.

The tail in *Cephalotes* is short and rudimentary, flattened, and formed of four or five very short joints, and not elongated and incurved as in the new genus.

I may observe that, though the index-finger of the *Cephalotes Peronii* from Celebes (in the British Museum, received from the Leyden Collection) is not provided with any distinct, well-developed claw, the end of the bone is curved upwards and rather produced into a resemblance of a claw,—there being no indication of such an appendage in the animal from Viti.

Pteropus amplexicaudatus, from Timor, has a rather elongated head, a short free tail; and the wings arise from the sides of the back, with a broad hairy space between their bases; but this differs from *Cephalotes* in having a small distinct claw on the end of the index-finger, and in having four chisel-shaped cutting teeth in the lower jaw, occupying the whole of the rather wide space between the base of the large canines; and it has four rather conical cutting teeth in the upper jaw.

NOTOPTERIS MACDONALDII.

Pale-reddish brown above, rather grayer beneath; the hinder half of the back, which is covered by the bases of the wings, bald, with a very narrow line of short hair down the vertebral line. The rump and upper surface of the base of the interfemoral membrane covered with hair.

Hab. The Island of Viti Leon, Feejees. September 1857. Male and female. Iris dark hazel. (*John D. Macdonald.*)

Male. Length of head and body 4½, tail 2, fore-arm bone 2¼, leg bone 1⅛ inch.

Female rather smaller: arm-bone 2⅛ inches.

NOTICE OF A NEW GENUS OF LOPHOBRANCHIATE FISHES FROM WESTERN AUSTRALIA. BY DR. J. E. GRAY, F.R.S., ETC.

Among the collections made by the Medical Officers of H.M.S. 'Herald,' above referred to, is a curious and apparently new species of *Syngnathidæ*, of which I give a brief description.

HALIICHTHYS.

Mouth elongate, quadrangular, with a spine on the middle of each

side of the upper edge. Body six-sided. Tail quadrangular. The shields of the head and body with a more or less elongated spine, each ending in a very long slender filiform beard. Under side of body and tail flat, with a very slightly raised central ridge. Pectoral and dorsal fin distinct. Caudal fin none, or very rudimentary. Egg-pouch ——? ; none apparent in the specimen.

HALIICHTHYS TÆNIOPHORA.

The head compressed, spinose, with a high, arched, central ridge armed with spines, each having an elongated slender filiform beard in front of its base ; the eye-brows produced, crested, with two large curved spines on the upper edge ; the front spine furnished with a very long filiform beard on the front edge ; the lower edge of the orbit with two spines, the base of the operculum with one, and the upper edge with a prominent ridge armed with two unequal spines, the hinder one largest and compressed. The head at the back edge of the operculum with an arched ridge armed with four large compressed conical spines ; and there is a compressed bifid one on the nape between these two arched ridges. Body hexangular, or subheptangular from the obscure ventral keel, formed of nineteen rings ; the lower lateral angles are narrower than the rest, which are subequal ; each plate of the rings is armed with a subcentral spine ; and the spines on the three or four darker rings of the body are furnished with elongated filiform beards. The tail is quadrangular ; the under side is rather the widest and flat, the others are concave ; each shield is furnished with a spine like those of the body, and the greater part of the spines are furnished with a filiform elongated beard. Caudal rings about forty-five, the apical one obscure. Dorsal fin over the vent 26-rayed.

The dry fish is black above, pale beneath, with three distant black spots on each side of the body, and distant black cross bands on the under side of the base of the tail.

Hab. Freycinet harbour, Shark's Bay, W. Australia.

Mr. Gould read the following extract from a Letter addressed to him by George Bennett, Esq., of Sydney, dated October 15th, 1858:—

"The semipalmated Goose, I have seen domesticated in Sydney in a poultry-yard, having been hatched by a common hen. This bird in its anatomy evidently approaches the Cranes, and in habits also. Especially when you see it running about the poultry-yard, it resembles one of the *Gruidæ* more than a Goose. The bird I allude to was one of many hatched under a hen from eggs procured from the blacks at a station on the Mooruya River, near Broulee, south of Sydney. Ten eggs were procured and placed under two hens, five for each, and in three days less than a month produced seven young Geese, which were reared by the foster-mother. The eggs are said to be cream-coloured, not larger than a small-sized goose-egg. The birds lay their eggs close to the water in the lagoons ; they commence to lay about September. The bird was an adult, and

differed materially from your drawing, which I consider to represent either a distinct species or, from the peculiarity of the bill and feet, a bird of the first year. The bill, feet, and legs were of a *flesh-colour*; the plumage of the head, neck, wings, centre of the back, tail, and thighs glossy-black; remainder of the plumage white. These birds are readily domesticated, and run about the poultry-yard in the most amicable manner possible. The beak, feet, and legs were of the same colour when hatched; and the bird, dating from the time it was brought forth, would be one year and eight months old."

MISCELLANEOUS.

Obituary Notice.—Arthur Henfrey, F.R.S. &c.

It is with the most painful feelings that we have to announce to our readers the death of Professor Arthur Henfrey, which took place on the 7th of September, at the age of thirty-nine. In the prime of life, in the fulness of his intellectual vigour—with the great battle of fame, the life-struggle of the professional man of science, nobly fought and won—with the rewards of his persevering and conscientious exertions within his grasp,—this great and gentle spirit has passed from the scene of his labours, leaving a mournful void in the affections of his personal friends, and casting a blight over those expectations which every one must have formed for him, of a brilliant and useful career in the department of science to which he had devoted himself.

Professor Arthur Henfrey was born at Aberdeen, of English parents, on the 1st of November, 1819. He studied medicine at St. Bartholomew's Hospital, where he was a great favourite with his teacher, Dr. Frederick Farre. On leaving the Hospital, in 1843, when he became a member of the Royal College of Surgeons, the delicate state of his health, arising from a tendency to bronchial affections which adhered to him throughout his life, prevented him from the practice of his profession; and from that time he devoted himself exclusively to the study of Botany, in which science he had already acquired great proficiency; and by a course of unremitting diligence in investigation, he speedily placed himself in the foremost rank of English botanists. In the year 1847 he was appointed Lecturer on Botany at the St. George's Hospital School of Medicine, and in 1854 succeeded the late Professor Edward Forbes in the Botanical chair at King's College. This position he retained until his death, and in the course of the last few years added to it the offices of Examiner in Natural Science at the Royal Military Academy and to the Society of Arts. At the same time his labours were incessant, both in botanical observation and in

literature; and it is to be feared that these unintermitted exertions in the cause of science must have been one of the causes of the melancholy catastrophe which we now deplore, as he was suddenly attacked by an effusion on the brain, which closed his life after only four days' illness.

It is almost unnecessary for us to dwell upon the scientific merits of Professor Henfrey; his claim to occupy a place in the first rank of botanists has long been undisputed, and the amount of work which he found time to perform is perfectly marvellous. Whilst constantly engaged in the personal investigation of the structure and physiology of plants, and in preparing the original papers in which his observations were communicated to the world, and which appeared in the pages of this Journal, in the 'Transactions' of the Royal and Linnean Societies, the 'Journal of the Agricultural Society,' &c., his untiring industry also enabled him not only to furnish numerous translations and abstracts of foreign memoirs to the Natural History Journals, and to review many botanical works in the pages of the same periodicals and of the 'Quarterly Review,' but also to translate several distinct works, both from the German and French languages, and to write some excellent elementary works on botanical subjects, of which his 'Elementary Course of Botany,' published in 1857, is the last and most important. For three years also he was editor of the 'Journal of the Photographic Society;' and since the commencement of the new series of the 'Annals,' in 1858, he has been one of its most active editors. Nor must the deep research and critical acumen displayed in the articles which he wrote in the 'Micrographic Dictionary' be forgotten, the last sheets of a second edition of which he had forwarded to the printer a few days before his decease.

With all this pressure of almost incessant toil upon his hands, with health which necessitated the greatest care at all times and often laid him for days upon a bed of sickness, the uniform kindness and gentleness of his disposition was never for a moment obscured; and while the vast stores of his knowledge, always freely offered for the instruction of his friends, must of themselves have generated a respect for him in the minds of all who came in contact with him, his friends alone could fully know the extreme amiability of character which coexisted in him with the highest intellectual powers and the most unwearying energy. The kindliness and charity which pervaded his whole nature, his true spirit, and his cheerful and unassuming manners, endeared him to all who knew him well; and his melancholy and untimely death leaves them the painful consciousness that his loss creates a vacancy which, to them, can never be supplied.

***Biographical Notice, with Extracts from the Correspondence, of the late Mr. Motley, who was massacred at Kalangan, May 1st,* 1859. By Henry Denny, A.L.S. &c.**

Mr. James Motley was born May 2nd, 1822, at Osmondthorp House, near Leeds, and inherited from his father, Thomas Motley, Esq., an ardent love for Natural History. A near relative, in a letter to me, says, "I was much with him in his early years. In our walks he could not pass a flower, or snail, or bee, that was new to him without stopping to examine it, and asking all about its habits. He knew the names of all the trees and plants at Osmondthorp before he could pronounce them; and his fondness for botany and geology increased with his riper years. He was educated at St. Peter's School, York, under the Rev. Mr. Creyke (now Archdeacon), and from thence entered St. John's College, Cambridge, to study for the Church; he eventually, however, chose Civil Engineering as a profession, to assist in some extensive mining operations which his father was connected with in Wales. These proving an unfortunate speculation in a pecuniary point of view*, he obtained, at the recommendation of Sir H. de la Beche, an appointment in a similar capacity at Labuan, and proceeded thither in February 1848, where he remained five years, when, owing to some disagreement with the Company under whom he went out, he left Borneo and passed a year at Singapore, when he again returned to Borneo under an engagement with a Dutch Company, formed at Batavia for working coal-mines in the Netherland Indian possessions. This proved an undertaking of no small labour, as he had to commence operations by a trigonometrical survey of the country and fixing the limits of the Company's possessions, which were only vaguely expressed in the contract. The spot selected, after more than 100 borings, was at Kalangan in Banjarmassing, on the south coast of Borneo. This speculation promised to be a successful one, the coal being of excellent quality, the pit containing three seams of coal of four feet six inches, three feet, and two feet respectively. The transport, however, from the pit was difficult, on account of the small river which was capable of carrying coal-boats being lost in a dense forest. Mr. Motley overcame this obstacle by cutting an entirely new one, which proved an interesting geological operation, as throwing much light on the formation of the coal-measures of the island which he considered as undoubtedly late Tertiary. He says, "I have here a coal-field so plainly growing under my eyes, and containing just the same plants as I find fossil in the measures we are working, that probably no one was ever in so favourable a position for observing even very minute points of resemblance. I have, in fact, the same state of things which would exist in the fen-counties of England if they possessed a tropical climate, or if man had never been there with dykes, dams, canals, and cultivation. The phæ-

* At this period he published a volume of poetry entitled 'Tales of the Cymri,' founded on the early traditions of Wales, which evinced considerable ability, both as a scholar and poet.

nomenon of social plants occupying the ground almost exclusively (a state of things which must have existed during the European coal æra to a great extent) can here be easily studied, while in England we have hardly more than two instances of social plants on a large scale, viz. *Calluna vulgaris* and *Zostera marina*; and of these only the latter grows under coal-making conditions, and would, I suspect, yield, when fossilized, just such ribands of carbonaceous matter as we see in many of the carboniferous shales. I must not anticipate too much, but I will only tell you that every time I go into the marshes (through which I have been cutting a canal of several miles in length) I see exemplifications of all sorts of coal-phænomena, so patent and evident as to make me feel almost clairvoyant for the last hundred thousand years or so. The fossils of our coal-measures, of which I possess about 200, comprise *Murex, Dolium, Mitra, Pyrula, Scalaria, Magilus, Cerithium, Strombus, Natica, Avicula, Hemicardium, Solen, Psammobia?*, several species of Crustacea and *Echinus, Flustra?*, a flustroid *Sertularia, Caryophyllea*, a Sponge, teeth of fish (chiefly *Squalidæ*, but very rare), a few scales, tooth of a *Diodon*, tooth of a Sauroid fish. Interstratified with these beds, which are frequently more or less calcareous, are shales with fossil resin in several states, and Dicotyledonous leaves, generally very imperfect; no Ferns, *Calamites, Lepidodendra*, and *Stigmaria*. I am now writing a paper, and have made large collections of notes on the coal-fields for the Society of Natural History at Batavia, of which I am a member"—besides attending to his laborious duties as Engineer! He employed a native collector of Natural History to proceed into the interior, who preserved skins and the specimens tolerably well; but, as he remarks, "I know, of course, less of the habits of the animals than I did of those at Labuan, where I collected and preserved them myself: my man has just returned from the interior after seven months' absence, and has brought me some novelties, among the rest an enormous Oran Outan." In another letter he says, "I do not forget Leeds or the Museum of the Philosophical Hall, which was my Alma Mater in what has always been the greatest pleasure of my life—Natural History. I will send you a lot of bird-skins, and some bottles of reptiles, and freshwater fish, freshwater and land shells, and an Ouran Outan if I can get one; my collector was in their district and got only two in two months. The three species inhabit very distant localities in different directions. He is now in pursuit of the small species; and I do not expect him back much before the end of the year. I hope he will bring me a fine lot of water-birds, as he goes to a district of freshwater marshes. I have commissioned him to get all the shells he can: half the land shells of Borneo seem to be new....The Cassowary is not here; it is said to be on the east coast, though I do not quite believe it; there may be one, but I am pretty certain, from the vague reports I have heard, that it is not the common one at all events....The Dugongs are rare on this coast; but I am also too far from the sea (16 miles of wilderness by land, and a day at least by the river) to get many marine specimens. I am, however, not sorry for this; for, although I am

very fond of marine zoology, I have here more chance of getting something new. I do more at present in Botany than in Natural History, and am in correspondence with Sir W. J. Hooker, to whom I have just sent 1300 species, also a collection of Cryptogams to Mr. Mitten of Hurst Pierpoint, a pupil of the veteran Bower. I have greatly improved my garden, which will soon be very beautiful. I have in cultivation about 150 species of *Orchideæ* alone, and a vast number of epiphytal Ferns. Of Palms I have now 26 species about my house; among the most interesting plants here are the Hoyas, of which we have an immense variety, and some among them very beautiful. I have a large collection. Their cultivation is not difficult; it is only necessary to hang them up on my garden paling, made of split palm-wood, and there they very soon fix themselves and are almost always in flower. I have managed to inoculate one of my pupils with a taste for Natural History, and we have commenced making together a collection of insects. Nobody who has not tried it knows the difficulty of keeping insects here from ants while drying. There are some species which seem proof against everything in the way of smell, except always balsam of copaiba; that never fails, but it is, after all, a perfume which one cannot well have about one's house or person. One of the miners here, a rough Northumbrian, declared, with many expletives, that he was d——d if he had not been three years in India and had seen a new sort of ant every day; and I think it quite possible that he could have done so. A collection of them would be very interesting; but I have been deterred by the difficulty of getting all the various states with any certainty of their identity in species. Do you know whether there exists any Monograph upon Ants? I am sorry to say I do not get very many Lice for you. I have told my hunter to collect them, and he has brought me some; but he says it makes his *skin creep* to collect them,—a feeling with which I must confess to have some sympathy, though I have no doubt it is a weakness you have got over long ago. I send two species—one from a large species of Heron akin to the Adjutant, and the other from a musk-scented *Sorex* whose name I do not yet know. There is a popular belief (whether true or not) that the Oran Outan has no lice; at least none have been found, and I suppose they must be very rare. The number of letters which I receive with requests for specimens from persons who have no claim upon me you would scarcely believe. I receive applications from literally the ends of the earth. I have now such from Calcutta, Sydney, New York, and New Orleans, all of which lie still sleeping in a bundle. I assure you it is not possible for me to answer all such letters, much less to send what they ask for. One person, from Germany, has had the coolness to ask me to furnish him with vocabularies of as many as possible of the dialects of Borneo. Talking of languages, Babel is reported to have been in Mesopotamia, but I believe it is here; I speak every day, more or less, four languages—English, French, Malay, and Dyak,—and I ought to speak Dutch; we have also Javanese, Chinese, Bangenese, &c."

From his zeal in the pursuit of Natural History, there is no doubt

that many valuable additions would have been the result of his labours if his life had been spared. In March last he despatched a box of specimens for the Leeds Museum, amongst which is a series of the fossils of the Borneo Coal-field, which must prove highly interesting, differing so materially as they do from those of the European Coal-fields: these have not yet arrived. Unfortunately, however, the same mail which brought a cheerful letter from him announcing the transmittal of the above, dated March 24th, in which he stated his first cargo of coals was being shipped for Samarang, brought also the sad intelligence of a revolt of the natives and the massacre of all the Europeans in Kalangan, on May 1st, a detailed account of which occurrence was subsequently transmitted to his father by one of the directors of the Company at Batavia. It was as follows:—

"Batavia, May 23, 1859.

"Dear Sir,—My name is perhaps only slightly known to you; but in the absence of my friend and co-director, Mr. Tiediman, it becomes my painful duty to communicate to you very sad tidings. I feel almost incompetent to the task, and had rather that another had been the instrument of bearing to a father's heart all the grief and sorrow which this letter will cause. I only trust, as I do earnestly pray, that He who is near to all who call upon Him in faith will afford you strength to receive with resignation the trials with which it has been His will to visit you. The Government steamer Ardgens, which arrived from Banjarmassing two days ago, has brought the fearful tidings of the destruction of our fine establishment of Kalangan, and the *murder* of our European *employés*, not leaving one of them alas! to tell the tale. The massacre took place on the morning of the 1st of this month. The people had been paid as usual on that day, and dispersed. Everything was quite quiet to all appearance; and though the insurgents were in movement about Pengaron and the neighbourhood, and had on the 28th made an unsuccessful attack on that place, no fears were entertained of an outbreak at Kalangan. Between seven and eight in the morning, however, the insurgents, assisted by some of the mine people, set about to do their work of carnage. The first of the establishment attacked, and immediately killed, was Overseer Hupperetz, and next to him Overseer Bovelt, and then your son, who, on the first report of disturbances, had left his house unarmed, and proceeded the length of the bridge, when, after a struggle of some duration, he was overcome by numbers, and fell an early victim. Mr. Wymalen was able to retire to his house, and defended himself and family for nearly three hours, when the house was set on fire, and four children were barbarously butchered. Mr. Van Heecheren, Mr. Eisager, and Dr. Huisaigen shared the same fate. Of Mrs. Motley and her three children it is also reported that they have not escaped; and in fact Mr. Ouddabye writes positively from Banjermassing to this effect; but, as this report is not confirmed in all its details, there may still remain a faint hope, but nothing more, that this excellent lady and her children, by the aid of servants, may have effected a temporary concealment, and escaped through the country. I would fain give

you hope on this point; but I must convey my conviction that the worst is almost certain, but cannot with certainty be known until the reinforcements to be despatched from this and Samarang in three or four days arrive there, and enable Colonel Anderson, the present acting resident, to recover Kalangan, or establish a communication with it. I sincerely trust to be able to give you certain tidings by next mail.

"Not only at Kalangan have these terrors been enacted, but near Poctoi Petak, in the missionary settlement, four missionaries, three of their wives, and nineteen children have been sacrificed; in fact, the intention of the insurgents seems to have been (incited by some priests lately returned from Mecca) to exterminate the whole of the Europeans in that division of Borneo; and in this they would have fully succeeded, had the small force under Col. Anderson arrived two days later, which alone enabled them to hold their ground at Banjermassing.

"I am well aware, my dear sir, that in affliction such as yours human sympathy will not console you; but that you may receive the precious consolations of Him who is to be found of all who call upon Him in time of trouble, is the earnest and sincere prayer of

"Yours very truly,

"Alex. Frazer.

"Thos. Motley, Esq., Stanley Terrace,
Douglas, Isle of Man."

On the 18th of July another letter was received from Mr. Motley, dated April 18th (the last he wrote), cautioning his father against any anxiety on his account should any rumour of disturbances in Borneo reach England, as he had himself heard some reports, which he did not believe. Alas! in twelve days more he had become a victim, and, it is too probable, all he held most dear in this world.

Philosophical Hall, Leeds, Aug. 11, 1859.

On a New British Snake. By Dr. J. E. Gray, F.R.S. &c.

The Hon. Arthur Russell has brought to the British Museum a specimen of a female *Coronella austriaca* (*Coluber lævis*, Lacépède), which was found near the flag-staff at Bournemouth in Hampshire.

This snake is commonly found in company with the *Lacerta stirpium*, which has only been discovered in England in the same locality. They are equally generally spread and common in different parts of Northern and Eastern Europe. The snake is said to feed often on the lizard. It is curious that as yet the lizard has only been seen in this single locality, though the sandy district in which they are found forms a broad belt across the south of England. The snake may have been overlooked as an Adder, as it is nearly of the colour of the paler specimens (about the usual size) of that species. It is easily known from it by the want of the lozenge-shaped spots on the back, which are replaced in *C. austriaca* by three rows of small darker spots, by the smooth sides, and the shielded head. There is a dark blotch on the crown, and a dark streak under the eyes on each side of the head.

On the genus Camptonyx.

M. P. Fischer, in the 'Journal de Conchyliologie' for June 1859, gives the genus *Camptonyx*, Benson, as a synonym of *Valenciennesia*, Rousseau, and includes the recent Kattiwár species, *C. Theobaldi*, as a second form of that genus.

M. Fischer could not have consulted the original paper in the 'Annals' for May 1858; otherwise he would have observed that the relations of *Camptonyx* with the fossil *Valenciennia* had been previously noticed, and that the different positions of the siphonal channels had been relied on as sufficient to prevent their union.

M. Fischer has attributed *Campt. Theobaldi* to Cochin China, while quoting the true habitat, "sur la péninsule qui sépare les Golfes de Kutch et de Cambay." The locality of this peninsula, between Bombay and the mouths of the Indus, will serve the views of M. Fischer still better than the remote station which he has erroneously assigned to the recent shell.—W. H. B.

September 26, 1850.

Anatomical and Physiological Investigation of the Pleurobranchus aurantiacus. By M. Lacaze-Duthiers.

Digestion.

Mouth protractile into a trunk; lingual bulb containing three corneous pieces: one median, comb-like, in consequence of the accumulation of an immense number of small sharp lamellar teeth; and two in the form of laterally symmetrical plates, covered with small points regularly arranged like the teeth of a file.

Œsophagus long. *Stomach* simple, large, placed on the left side. *Intestine* short, without convolutions, scarcely flexuous, opening on the right side behind the branchia.

Accessory glands.—*Liver* voluminous, blackish, its excretory canals opening at the union of the stomach and intestine, formed of cæca with cellular contents, often occupied by calcareous calculi or calculi of some other nature, probably biliary, usually of a dark tint.

Two kinds of salivary glands, one of which, not yet described, as far as I know, is placed upon the dorsal face of the pedal disk, that is to say, upon the lower floor of the visceral cavity, and opens by a single canal between the trunk and the tongue; it is formed of large cæca, clothed with a cellular tissue of very large cells. The other salivary glands are identical with those of other Mollusca, except that their position is different, their parenchyma being intermixed with the liver.

Circulation.

The study of this is most important. The *venous circulation* is lacunar in the highest degree. The tissue of the animal swells up like a sponge; great venous tissues, irregular around the stomach, circular at the base of the foot and of the dorsal tegumentary lobe, conduct the blood, on the one hand to the branchia, on the other to the branchial vein, near its union with the auricle.

Heart transverse and dorsal. *Arterial circulation* analogous to that presented by the other Mollusca.

The external orifice of the apparatus of circulation, placed above the generative apertures upon the right side before the branchial vein, in the form of a button-hole, is only visible in dead and much-softened animals. It disappears with the greatest facility amidst the wrinkles produced by the contractions. It communicates with a canal which opens into the vein coming from the branchia, in front of the auricle. The internal opening of this canal into the vein is oblique, and placed upon a falciform fold directed towards the heart, which may evidently play the part of a valve.

All injections, whatever be their nature, or the means by which they are propelled, reach the heart by this orifice from the exterior.

The external orifices of the circulation have not been remarked and well determined upon the integuments of any of the Mollusca, except the *Dentalia* and *Pleurobranchi*. In these examples ruptures cannot have been taken for orifices. I hope to be able to generalize this fact, not by considerations independent of observation, but by anatomical data, which everything leads me to think accurate. I should mention that Gegenbaur, Leuckart, and Langer have already indicated relations between the circulatory apparatus and the exterior, by the intermediation, however, of the *corpus Bojani* either directly or through the pericardium in the Pteropoda and Acephala. We have this fact now demonstrated also in the Gasteropoda.

It is evident, if we come to the generalization of these facts, that the ideas we have of the nutrition of animals, taking the higher creatures as our type, must be modified for the Mollusca; and the circulation in this group will no doubt present itself in quite a new light.

Nervous System.

Three ganglionic centres, as in the other Mollusca. The supra-œsophageal and pedal ganglia very distinct, forming a collar. The right postero-lateral ganglion (the same designated by authors by different names, such as pallio-splanchnic, genito-respirator, &c.) very small, placed close to the collar on the right side.

This last centre furnishes two very slender nerves, of which one passes to the generative organs, the other to the branchia.

From the *pedal centre* the nerves of the foot arise. The otolithes are applied against it.

From the *supra-œsophageal centre* arise the nerves of the tentacles, of the supra-buccal velum, of the trunk, the eyes, and the dorsal tegumentary lobe. The two latter are very voluminous. One of them, that of the right side, gives off very distinct filaments to the branchia. It appears, therefore, that the right postero-lateral ganglia, called respiratory ganglia by some authors, are not the only ones that preside over the function of respiration.

The *great sympathetic nerve* is well developed, arises by two origins from the supra-œsophageal ganglia, forms two ganglia under the œsophagus, and is distributed over the digestive tube and the

lingual apparatus. The trunk and the tongue are thus clearly distinguished by the nature of the nerves which animate them.

Reproduction.

Hermaphroditism; fundamental and accessory glands, as well as the other parts, analogous in structure and arrangement to those found in most Gasteropoda.

Special Secretions.

The skin is filled with triangular spicula, or with oval calcareous particles. The latter occur (although in form less regular than in the skin) in the walls of the digestive tube, and even in the neurilemma of the nerves.

The *corpus Bojani* is placed to the right of the mass of the viscera, and is entirely internal; it turns under the branchia by a distinct pore, which is easily seen. This forbids the supposition which might perhaps be raised, that the excretory pore of the *corpus Bojani* has been mistaken in this case for the internal orifice of the circulation. In *Pleurobranchus testudinarius* I have met with numerous calculi in the interior of its tissue. With nitric acid and ammonia they gave the well-known purple-red colour characteristic of uric acid. This is a fresh proof, in addition to so many others, that this body may be regarded as a kidney.—*Comptes Rendus*, June 27, 1859, p. 1155.

Note on Cyclostoma articulatum. By S. P. Woodward, F.G.S.

This land-snail is peculiar to the Island of Rodriguez, and belongs to the subgenus *Tropidophora* (Troschel), characteristic of the Mascarene Islands. Numerous examples were collected in February 1858 by the late Madame Ida Pfeiffer, who conveyed them to the Mauritius, where they continued active, but took no food during a stay of two months. Three individuals remained alive after the voyage to England, which occupied ten weeks; and several others were sufficiently preserved for examination. They were brought over packed in paper and rags, in a tin pot with a lid, and were not taken out until a fortnight after their arrival. One of these snails lived for some months under a bell-glass with moss and ferns, and afforded frequent opportunities for examination. The animal was of a pale buff colour, with darker tentacles and muzzle; the tentacles were acute, rugose, and slightly annulated; the muzzle annulated, grooved beneath, and bilobed at the end, which was constantly used in walking. The foot was ample, with a deep central groove dividing it into two lateral elements moved alternately in walking. When it retired and closed its shell, it still adhered, and sometimes became suspended, by a tenacious thread of mucus.

Madame Pfeiffer also brought home specimens of *Cyclostoma carinatum* and *C.* (*Otopoma*) *Listeri*, from Mauritius, which were in a tolerably fresh state. The lingual dentition of these species differs slightly from that of *C. articulatum*.—*Proc. Zool. Soc.* May 24, 1859.

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XXXIII.—*On the Reproduction of the Bark-Lice* (Chermes, &c.); *a further Contribution to the Knowledge of Parthenogenesis.* By Rudolph Leuckart*.

[With a Plate.]

In my small work upon the alternation of generations and parthenogenesis in Insects (Frankfort, 1858), I have proved that a spontaneous evolution of the eggs takes place in the *Coccina* and allied animals. Among the latter I particularly cited the genus *Chermes*, which is usually referred to the Aphides by entomologists, and may indeed approach most closely to those animals on the whole, although in many respects it constitutes the transition to the *Coccina*.

What I was able to state then with regard to *Chermes* related, however, exclusively to the wingless generation of these so-called Bark-lice. I had ascertained that all the individuals of this generation were of the female sex, and that they laid eggs capable of evolution without the cooperation of males. The winged individuals had not at that time been investigated, with the exception of a few specimens of *C. Laricis*, which were also found to be virgin females.

Hoping to be able to extend my observations to the latter also, and thus to obtain an insight into the entire history of the reproduction of these remarkable creatures, my statements with regard to *Chermes* in general were rather short and aphoristic, forming to a certain extent only an appendix to the observations upon the *Coccina* and the Aphides with viviparous generations.

As I have paid much attention to the animals in question in the course of the past summer, and, in my opinion, have arrived

* Translated from the 'Archiv für Naturgeschichte,' 1859, p. 209, by W. S. Dallas, F.L.S., Keeper of the York Museum.

at a pretty good conclusion with regard to them, I have thought it the less advisable to keep back my observations, as they not only furnish us with a new and interesting contribution to the knowledge of Parthenogenesis, but also throw some light upon many other long-known peculiarities in the reproduction of insects.

But, before I commence with the special exposition of my investigations, a few words on the mode of life of the animals may not be out of place, so far as this may be ascertained by mere external observation, especially as it is fully described from actual observation in the works of De Geer (Mémoires, tome iii. pp. 66–84, tab. 8), Kaltenbach (Monographie der Familien der Pflanzenläuse, 1843, pp. 193–206), and Ratzeburg (Forstinsekten, 1847, Theil iii. pp. 195–205, tab. 12, 13)*.

We treat in the first place of the common Fir-louse (*C. Abietis*, Linn.), which is divided into two species by both the last-mentioned authors, namely *C. Abietis*, Kalt. = *C. viridis*, Ratzeb., and *C. strobilobius*, Kalt. = *C. coccineus*, Ratzeb. The distinction of these two species, which, however, may be justified by the size and position of their galls, is of no consequence to us; for both forms, which are very nearly allied even externally, agree so closely biologically and anatomically, that I have looked in vain for a distinction between them. (I will not, however, omit to mention, in passing, that my investigations were made principally upon the first of these two species or varieties.)

By the investigations of the above-mentioned entomologists it is satisfactorily established that the Fir-louse passes the winter in the wingless state, in the form of a plump insect not larger than a grain of sand, beneath the protective covering of a whitish woolly coat, at the base of the scaly young buds of the Fir. It is only in the following spring (April) that the little animal begins to grow. It is then always found in its old place, immoveable; and on closer examination its rostrum is observed to be inserted deeply into the axis of the awakening bud. That our insect pierces the individual leaves, as asserted by Kaltenbach and also by De Geer, is incorrect; I have never seen it elsewhere than in the above situation, and might even suppose that it remains in this position until its death, without ever changing the place of insertion of its rostrum to any extent. Close above the perforation, even at this time, before the evolution of the buds, the axis of the young shoot, with the leaves attached to it, begins to swell; thus commences the first founda-

* Hartig's memoir (Germar's Zeitschrift für die Entomol. iii. p. 366) is not in my possession at the moment; and I pass it over with the less reluctance, as his statements are frequently inaccurate and erroneous,—at least as regards *C. Abietis*.

tion of those remarkable pine-apple-like galls which, as we shall see hereafter, serve as the dwelling-place of the second generation of our animal.

After the Fir-louse, constantly increasing in size, has repeatedly changed its skin in the course of the next three weeks, and at the same time renewed its woolly covering (Kaltenbach), which, as is well known, pushes out gradually from the skin of the body in single threads, as a secretion (wax ?), the oviposition commences, still before the evolution of the young shoot. The eggs are attached to the bud behind the mother by means of a short style, and are usually also clothed at the same time with cast woolly threads; they gradually accumulate here in such quantities, that as many as 200 of them may not unfrequently be counted* towards the close of the oviposition, which, indeed, does not arrive until the death of the mother, when the oldest eggs are already hatched.

The exclusion of the young takes place in the latter half of May, soon after the young shoot has broken out through the enveloping scales with its axis, which is abbreviated and thickened at its lower end. The young brood immediately quits its birthplace, and moves forward in a mass, to find a new dwelling between the closely approximated swelled leaves of the shortened shoot. Here the young brood completes what its mother had begun. Hundreds of suckers sink into the juicy leaves; and under the influence of this continual irritation the leaves close up to form that globular or oval head† which we have already mentioned as the dwelling-place of the second generation. An amalgamation of the leaves, such as has been supposed by some, does not take place, although their outer margins are closely applied to each other. Tolerably spacious cell-like cavities also remain between the leaves in the interior; and each of these is almost constantly inhabited by several young plant-lice, sometimes a dozen together.

These animals of the second generation are more slender and mobile than the individuals which have lived through the winter, from which we started in our investigations; they also appear to be by no means so continually attached by the rostrum. At least, on opening a cell, a number of animals living free in the interior are almost always found, whilst the rest adhere to the walls. These animals, like their free parents, clothe themselves

* Kaltenbach is far below the mark when he estimates the number of eggs deposited by a single mother "at thirty or more."

† Very frequently, however, these galls are attached excentrically upon the shoot, and are then, of course, less regularly rounded. Perhaps in such cases the insect has not penetrated with its rostrum quite to the middle of the abbreviated axis.

with a woolly down, but this is very much shorter. Like their parents, they are subject to a repeated change of skin as the size of their bodies increases, but they do not by this means perceptibly alter in their appearance. Towards the end of July these larvæ become converted into pupæ; they then present wing-cases, and are all attached, almost immoveably, with the legs retracted, by means of the rostrum, to the wall of the cell. In about a fortnight the metamorphosis is complete; the cells of the galls open, by the separation of the leaves, which gradually dry; and from the gaping fissures the crowd of pupæ, which have again become capable of motion, escape, usually in the sunshine. These ascend the leaves in the vicinity, cling firmly with their legs, and then, by another change of skin, become converted in a few minutes into winged Aphis-like creatures, which remain sitting close together for a time on the leaves, and then disperse in all directions.

In the course of a few days, single individuals of these Aphides are found dead, with their wings spread out in a rooflike form, here and there upon the leaves, and beneath them a small aggregation of pedunculated eggs, partly enveloped in the woolly hairs, adhering to the abdomen of the mother. The young, which escape from the eggs in the course of a few weeks, disperse themselves, and seek the developed buds in the vicinity, usually singly, seldom two or more together; upon these, as above stated, they hibernate, and in the next year, with a more abundant nourishment, produce a new progeny.

Our present knowledge of the Fir-lice is confined to the preceding observations. No one has yet seen the copulation of these animals, nor has any one yet proved with certainty the existence of a male. It is a mere assumption that a copulation precedes the oviposition of the winged animals; and it is nothing more than an assumption when Ratzeburg (*op. cit.* p. 201) regards the smaller individuals of this winged generation as males, and considers the elongated form of their abdomen, and the presence of an obtuse penis-like organ (*Ruthe*) protrusible by pressure with the compressorium, as characteristic attributes of their sex. The same questions still remain to be answered with regard to the reproduction of the Fir-lice, that De Geer proposes at the end of his account of the natural history of these animals.

I am happy that my investigations enable me to give some more definite information upon the conditions in question. This, however, is not in favour of an opinion which not long since held the place of an irrefragable law, and which also influenced the earlier observers in their suppositions.

I have convinced myself that the reproduction of our Fir-lice

takes place in both generations by a parthenogenetic process, by the spontaneous development of the eggs.

Although I have examined fully two hundred of our animals, I have never met with a male among them. All the individuals, wingless and winged, large and small, were females, and, indeed, virgin females. This was the case not only with animals taken before oviposition, but also with those engaged in depositing their eggs, and even with those whose eggs already presented distinct traces of the commencement of evolution, or even contained developed embryos. More than once I isolated the eggs of such virgin animals, and afterwards saw them hatch.

After such observations, there can be no doubt that the Fir-lice generally propagate without males. But whether males are entirely wanting, or whether they merely make their appearance from time to time, under certain favourable circumstances, and then fecundate the females, I must leave undecided; yet it almost appears to me as if certain anatomical conditions, to which I shall have to refer hereafter, rendered the first supposition to a certain extent credible.

It is, however, not only the common Fir-louse (*C. Abietis*) that behaves in this manner. Towards the end of April I several times observed on the young shoots of the Fir a wingless Louse (*C. Piceæ*, Ratzeb.?), which presented an extraordinary resemblance to the individuals of the first generation of *C. Abietis*, but was distinguished therefrom partly by its darker, almost black colour, and partly by its far smaller size. I can state nothing with regard to the mode of life of this species: I afterwards sought in vain upon the infected trees for galls, and must leave it undecided whether our animal, like *C. Abietis*, subsequently produces a second winged generation; this, however, is very probable. But I am certain that all the individuals examined, amongst which were several with eggs already deposited although not numerous, proved to be unfecundated females, exactly as in the corresponding state of *C. Abietis*.

I can assert the same thing of the nearly allied *Phylloxera coccinea*, Von Heyden, of which I met with numerous wingless females, at the commencement of July, on the lower surface of oak-leaves, with eggs deposited in rings. In this case, also, the older eggs (about 30–40 in number) contained an embryo already far advanced in development, although no trace of semen was to be detected in the mothers. Previous observers have overlooked the existence of this first generation of wingless females: they speak of winged animals which made their appearance in August and September, and fastened their eggs to the oak-leaves exactly in the same way as the wingless females. Unfortunately, I have not succeeded in finding these winged

Phylloxeræ, but I have scarcely any doubt that they would have proved without exception to be female animals. From all analogy, these winged individuals are the progeny of the wingless forms observed by me, which, on their part, represent the first generation of *Chermes*, and will have passed the winter either as young animals, or, as their later appearance would almost lead us to believe, as eggs.

If the latter supposition be well founded, our *Phylloxera* would be distinguished thereby not only from *Chermes Abietis**, but also from *C. Laricis*, which otherwise approaches it most closely in form and mode of life (residence on the surface of the leaves, and incapability of forming galls).

With regard to the conditions of reproduction, however, the same statements apply to the latter as to other species previously referred to. The Larch-louse also only exhibits the female sex in both wingless and winged individuals; it always consists, as far as I am aware, only of parthenogenetic virgins.

But with regard to the relation in which these two forms of individuals stand to each other, I have not been able to arrive at so clear a conclusion as in the case of *C. Abietis*. Nevertheless it almost appears as if *C. Laricis* behaved somewhat differently in this respect. According to the statements of Kaltenbach and Ratzeburg, there is indeed no doubt that the minute creatures which pass the winter on the still undeveloped buds are developed first of all only into wingless individuals; but it is equally certain that in this case the winged individuals make their appearance very early, and occur for a long time together with wingless females. I found such winged individuals as early as the end of May, a few weeks after the first eggs, which in this species are but few in number, were met with. Moreover, according to Ratzeburg's observations, the eggs of the first generation do not produce winged individuals exclusively, as in *C. Abietis*, but wingless forms are produced at the same time; the latter, however, are somewhat different from the original wingless animals, and produce a third generation in the same year. That the winged individuals lay eggs, like the wingless ones, was unknown to Ratzeburg; I have, however, convinced myself of this in the most certain manner, but must remark that the number of these eggs is less than that produced by the wingless females.

By the greater number of the consecutive generations, and also by the fact that these generations are represented, at least in part, simultaneously by winged and wingless individuals,

* It was by mistake that, in my memoir on the alternation of generations and Parthenogenesis in insects, I stated that the eggs of *C. Abietis* passed through the winter.

Chermes Laricis evidently approaches the ordinary Aphides in its conditions of reproduction, except that the viviparous individuals, as also in *Phylloxera*, are replaced by egg-laying females, and that male individuals are entirely wanting (at least, as a general rule).

[To be continued.]

XXXIV.—*On some new Anthribidæ.* By Francis P. Pascoe, F.L.S. &c.

In common with many other families of Coleoptera, the Anthribidæ have received very little attention from entomologists. This is, perhaps, partly owing to their being scattered in small numbers over every part of the world, and Europe possessing only about twenty of them out of the twelve hundred which our collections are calculated to contain. Of these, according to M. Jekel, who has specially studied the family, not more than two hundred are published; and there are consequently a number of new forms, only a few of which I have here attempted to describe, and these principally derived from Mr. Wallace's researches in the Indian Archipelago. Indeed the family may be considered to have its head-quarters in those islands: in all Mr. Wallace's collections, including those from New Guinea, they formed, from the number both of species and individuals, a very characteristic feature, and in this respect afforded a marked contrast to collections from extra-tropical Australia. It is probable, however, that we shall hereafter find the northern or tropical part of the Australian continent to assimilate more to the opposite shores of New Guinea, and that the very distinctly marked region extending from Java to the latter island will have Ceylon, and perhaps a portion of Southern India, on the one hand, with tropical Australia, and not New Guinea, on the other, as outlying or transition provinces.

As no attempt has yet been made to classify the family, which contains at least three distinct types of form, I have thought it best to avoid any remarks respecting the affinities or position of the new genera here proposed*. It is, perhaps, as well also to observe that the individuals of many Anthribidæ vary much more than is usual in regard to size, markings, and the relative proportion of their parts, particularly of the rostrum and antennæ.

* In order to condense as much as possible, I have generally omitted all characters which belong to the Anthribidæ as a family; and even those here given may perhaps hereafter be curtailed without disadvantage.

Xenocerus insignis.

X. aterrimus, albo-varius; antennis tarsisque albo-annulatis.

♂ antennis corpore quadruplo longioribus, articulis quarto et quinto basi albis.

♀ antennis dimidio corporis vix longioribus, articulis quarto et quinto basi, septimo basi excepta, et octavo albis.

Hab. Amboyna.

Male. Deep black; two lines between the eyes, a spot on the front, three stripes on the prothorax (the lateral ones shorter and narrower), a sutural patch expanding below the middle into a broad band, and sides of the thorax beneath, white; antennæ four times as long as the body, base of the fourth and fifth joints white; tarsi with the base of the first and second joints of the four posterior, and the base of the last of the posterior only, whitish-cinereous. In the *female,* the white on the prothorax is more diffused, shading gradually into the black, and the whole of the upper two-thirds of the elytra is white, except at the shoulders and two black spots near the centre of the patch; the tarsi have all the joints, except the penultimate, whitish at the base. Length 10 lines.

Nearly allied to, or perhaps only a variety of *X. semiluctuosus,* Bl.

ZYGÆNODES.

Head broadly triangular in front, expanded at the sides into a thin process bearing the eye. Antennæ slender, longer than the body, 11-jointed, the first thick and longer than the second, which is short and obconic, the remainder filiform and subequal, except the three last, which are somewhat stouter; antennal groove broad, commencing beneath the lateral process, and continued to the mandible. Eye oblong. Labrum very small. Mandibles robust. Maxillary palpi moderate, pointed. Prothorax transverse, width of the elytra, semicircular anteriorly, narrowed suddenly behind, the carina distant from the base, and curving shortly round to the front. Elytra short. Legs moderate; anterior coxæ approximate, the middle distant; first tarsal joint longer than the rest together. Prosternum simple; mesosternum broad, truncate posteriorly.

Zygænodes Wollastoni.

Z. nigra, guttis cinereo-albis ornata; capite antice cinereo-albo.

Hab. Borneo.

Dull black, pubescent; head between the eyes, prothorax, and elytra, covered with small ashy-white spots; front of the head from the eyes to the mandibles entirely ashy-white; body beneath, and legs, with a pale ashy pubescence. Length 8 lines.

Dedicated to the author of 'Insecta Maderensia.'

Corrhecerus Jekelii.

C. rufo-brunneus, ochraceo-irroratus; oculis auratis; pedibus ochraceis, tarsis brunneo variis.

Hab. Brazil (Para).

Reddish brown, closely pubescent, with numerous small ochreous spots, which on the elytra are more or less confluent, giving them a somewhat patchy appearance; antennæ reddish brown, the club darker, except the last joint, which is white; under surface and legs ochreous, the last three tarsal joints of the anterior and middle two of the four posterior dark reddish brown; eyes golden brown. Length 3½ lines.

The antennæ are ciliated, as in *C. barbicornis*, F., but the eyes are rather more reniform. Dedicated to M. Henri Jekel of Paris, author of 'Fabricia Entomologica' and other works.

NESSIA.

Head sub-depressed; rostrum very broad. Labial palpi elongate, hairy. Eyes obliquely oblong. Antennæ short, arising from beneath the rostrum; the first and second joints robust, the rest slender and gradually decreasing in length, the ninth and tenth shortly triangular, and, with the eleventh, forming a compressed club; all the joints with a setose hair at their tips on each side; antennal groove deep, directed obliquely outwards. Prothorax narrowed in front, the carina sub-basal, passing obliquely downwards at the side to about half the length of the prothorax, and terminating in a recurved hook. Elytra rather short, subdepressed. Legs moderate; tarsi short, the first and last joints of nearly equal length.

Nessia didyma.

N. hirta, rufo-brunnea, sparsim nigro-maculata; elytris basi striato-punctatis, singulis apicem versus maculis duabus albis.

Hab. Borneo.

Clothed with short, dense, reddish-brown hairs; rostrum and round the eyes yellowish; two black interrupted stripes on the prothorax; elytra striato-punctate chiefly near the base, with a a few scattered black spots, one especially near the apex larger than the rest, above this are placed two narrow approximate white spots; under surface with a dull greyish pubescence; eyes black. Length 6 lines.

Nessia centralis.

N. rufo-brunnea, flavescenti-hirta; elytris macula magna communi rufo-fusca.

Hab. Borneo.

Light reddish brown, clothed with short yellowish hairs; the

prothorax clouded with darker brown; elytra slightly striated, with a few brownish spots and a large deep chocolate-brown patch in the middle common to both; beneath brown, with a dull greyish pile; eyes black. Length 3½ lines.

Litocerus mœstus.

L. anthracinus, obscure cinereo-guttatus; antennis basi rufo-piceis.

Hab. Borneo.

Shining bluish-black, with several small, scattered, dull ashy spots; rostrum broad, finely punctured; prothorax rather transverse; elytra broadly punctate-striate; antennæ with the two basal joints pitchy red, beneath dull black. Length 3 lines.

Litocerus figuratus.

L. cervino-brunneus, fusco-maculatus; rostri dimidio basali griseo; antennarum articulis tribus basalibus testaceis.

Hab. Borneo.

Light reddish brown, with large distinct stripes and spots of dark chocolate-brown; prothorax with two principal stripes and an irregular ring on each side; elytra with an oblong spot, followed by another below, which expands on each side into an irregular cruciform figure, between this and the shoulder, other irregular spots, varying a little in individuals; legs testaceous brown, slightly varied with darker; rostrum with the basal half greyish; antennæ dark brown, with the three basal joints testaceous. Length 4 lines.

Apparently allied to *L. maculatus*, Ol.

Litocerus sellatus.

L. fuscus, sparsim ochraceo-guttatus; elytris medium versus plaga magna communi ochracea; antennis dimidio basali testaceo-variis.

Hab. Borneo.

Dark brown, pubescent, sparingly spotted with ochraceous; elytra slightly punctate-striate, with a large common transverse ochraceous spot before the middle; antennæ with the lower half of the basal joints testaceous. Length 3 lines.

Eczesaris.

Head moderate, narrowed below the eyes, dilated at the apex, the rostrum tricarinated. Antennæ half as long as the body, the first two joints short and thick, the third to the eighth very slender, the ninth and tenth broadly triangular, and, with the last, forming a short club. Antennal groove short, oblique. Eyes oblong. Palpi short; terminal joint of the labial ovate, hairy internally; maxillary pointed. Labium transversely qua-

drate. Prothorax narrowed anteriorly; the carina sub-basal, slightly curved forwards at the angle. Elytra short, rounded at the sides and apex. Legs moderate, middle coxæ somewhat distant, tibiæ very stout, first tarsal joint elongate.

Eczesaris atomaria.

E. nigra, ochraceo-irrorata; antennarum articulis 3–8° brunneis; oculis auratis; tarsorum articulo ultimo albo.

Hab. Aru.

Dull black, pubescent, everywhere covered, except the tarsi, with small, distinct, ochraceous spots; eyes golden brown; antennæ with the third to the eighth joints rufous brown; tibiæ and tarsi closely ciliated, the last joint of all the tarsi white. Length 4 lines.

Acorynus rusticus.

A. pubescens, fuscus, obscure ferrugineo ochraceo fuscoque varius; prothorace subvittato; elytris fusco-maculatis; antennis rufo-piceis.

Hab. Borneo.

Pubescent, brownish, varied with dull rusty ochraceous and dark brown patches, which on the prothorax assume somewhat the form of stripes of dark brown and ochraceous only, but on the elytra the ochraceous is mingled with light brown, the dark brown forming three distinct spots on each, placed longitudinally; antennæ reddish pitchy; legs varied with ochraceous, especially on the femora and apical half of the first tarsal joints; under surface with short rusty ochraceous hairs. Length 7 lines.

Acorynus amabilis.

A. tomentosus, pallide rufo-griseus; prothoracis disco bivittato; elytris macula basali, alteraque apice, et pone medium fascia maculiformi fuscis; antennis, tarsis tibiisque fuscis.

Hab. Aru.

Covered with a short, dense, pale reddish-grey pile; rostrum in front, mandibles, eyes, and antennæ black; prothorax with two broad brownish bands on the disc; elytra rather short, a little swollen at the base, with slightly oblique striæ, a spot at the shoulder, a smaller one at the apex, and a spot-like band below the middle dark brown; lower part of the tibiæ and tarsi black. Length 5 lines.

DIPIEZA.

Head small, rounded in front, without a rostrum. Antennæ (♂) very short, inserted before the eye, the first joint moderate,

thickened, the second longer than the third, the fourth longest, rather compressed and very much enlarged, fifth to the eighth shortly conic, the three last forming a compact, somewhat compressed club. Eye oblong, slightly emarginate. Palpi moderate, pointed. Antennal groove obsolete. Prothorax rounded anteriorly, broadest behind, the carina close to the elytra, bent forwards and downwards, and terminating at half the length of the prothorax. Elytra elongate, cylindrical, as wide as the prothorax. Legs short; coxæ of the middle pair approximate. Abdomen of six segments.

It is possible that this may be the same as *Œdecerus* of M. Montrouzier (Faune de Woodlark, p. 46); but he describes the *third* antennal joint as being the enlarged one, and the club as consisting of *four* joints.

Dipieza Waterhousei.

D. cylindrica, elongata, lanuginosa, albo vel griseo fuscoque varia; antennarum articulo quarto clavaque nigris, reliquis rufo-testaceis.

Hab. Aru.

Elongate cylindrical, covered with coarse curled hairs; head pale greyish brown; prothorax indistinctly striped with brown, greyish and a little white; elytra greyish at the shoulders; a large discal patch also greyish mixed with dark brown, around this and the apex white, the latter with two dark brown spots; legs varied with grey and white; eyes, fourth antennal joint, and the club black, the rest of the joints reddish yellow; under surface covered with whitish hairs. Length 4 lines.

Dedicated to G. R. Waterhouse, Esq., of the British Museum.

PENESTICA.

Head flattened in front, concealed above by the prothorax; the rostrum but slightly developed. Antennæ short, the first three joints subequal and longest, the fourth shorter, fifth to the eighth gradually shorter and broader, the three last forming a somewhat dilated club. Maxillary palpi slender, pointed. Prothorax rounded anteriorly, very convex, the carina basal, and extending at a right angle along the side. Elytra shortly cylindrical. Legs moderate; coxæ of the middle pair distant; tarsi short.

Penestica inepta.

P. hirta, albescens, griseo nigroque varia; antennis piceo-rufis, clava nigra.

Hab. Aru.

Covered with whitish, varied with grey and dark brown, short,

close-set hairs; prothorax clouded with grey and having a few indistinct dark brown patches; elytra obliquely striated at the base, with fine greyish patches (in each of which is a central dark brown spot)—*i. e.* one at the base and one at the apex of each elytron, and a large common transverse one in the middle,—the sides also greyish; legs and under surface greyish white; antennæ pitchy red, with the club and eyes black. Length 3 lines.

[To be continued.]

XXXV.—*On the Nomenclature of the* Foraminifera. By W. K. Parker, M. Micr. Soc., and T. R. Jones, F.G.S.

II. *On the Species enumerated by Walker and Montagu.*

The Foraminifera figured and described in Walker's 'Test. Min.'—Subsequently to 1758 (the date of Linnæus's 10th edition of the 'Systema Naturæ'), and prior to 1789, when Gmelin produced his edition of the 'Syst. Nat.', several authors noticed and figured recent and fossil Foraminifera. Among these, Ledermüller (1764) figured several, but did not aim at giving either specific determinations, or even names. Martini (1769) merely copied the figures and names given by Gualtieri and Plancus; and so also did others. Guettard (1770) figured several forms of fossil Nummulites, Orbitolites, &c., which may be more or less easily recognized. Schroeter (1776–87), Gronovius (1781), and Spengler (1781)* supplied valuable materials for the Rhizopodist, as we have indicated in our former paper (Annals and Mag. N. H. 3 ser. vol. iii. p. 474). Soldani (1780) in his 'Saggio orittografico,' &c., illustrated a large series of Foraminifera, but did not adopt the binomial nomenclature in his descriptions. We shall turn to the consideration of this work when we take in hand the much larger, and indeed enormous, accumulation of microzoic materials which Soldani has so industriously and elaborately depicted in his great work, 'Testaceographia et Zoophytographia,' &c. (1789–98).

There is, however, one work of the period referred to that requires of us critical examination, as far as the Foraminifera figured and described in it are concerned; and therefore, in pursuance of the object of these papers, we now offer some remarks on the species and varieties of Foraminifera represented by the figures in plates 1 and 3 of the 'Testacea minuta rariora,' &c., by G. Walker†.

* This date was inadvertently omitted in our last communication. In the Bibliographic list appended to Prof. Williamson's 'Monograph. Brit. Foram.' (p. 102) this date should be attached to the reference to Spengler.

† Testacea minuta rariora nuperrime detecta in arena littoris Sandvi-

The history and character of this work are so well given by Prof. Williamson in his elegant Monograph on the Recent Foraminifera of Great Britain (1857) that we borrow the following extract from pages v and vi of the introduction of that work:—

"The earliest British writer in whose works I have discovered any notice of the Foraminifera is Hooker, the father of microscopical science in this country. In his 'Micrographia,' published in 1665, he figures a single specimen, apparently of a Rotalia, which he found in some sea-sand. This figure is copied in the 'Micrographia Illustrata' of the elder Adams (1747). No further progress was made until the time of Mr. Boys, the well-known conchologist, whose labours converted Sandwich Bay into classic ground. His discoveries amongst minute shells led to the publication of the 'Testacea Minuta Rariora,' for which work the drawings were made by Mr. George Walker, an intelligent bookseller at Faversham, whilst the well-known Edward Jacob wrote the descriptions*. The volume contained thirty-six figures of Foraminifera, divided into twenty-two supposed species; but the descriptions are very brief, rarely exceeding half-a-dozen words; and though the twelfth and thirteenth editions of Linnæus's 'Systema Naturæ' had appeared, containing both descriptions and binomial designations for the Linnæan forms, Walker avoided assigning trivial names to his objects, 'through the fear of giving such as might in any way interfere with those already given by Linnæus to shells of the same kinds†.' The fact that subsequent conchologists have usually ascribed to Walker several of the specific names now employed, requires a word in explanation. In 1787, George Adams the younger published his volume of 'Essays on the Microscope.' A second edition of this work, with considerable additions and improvements, appeared in 1798, edited by Frederic Kanmacher, who introduced into this edition Walker's figures of the Foraminifera, and appended to them generic and specific names in

censis a Gul. Boys, Arm. S.A.S. Multa adidit, et omnium Figuras ope Microscopii ampliatas accurate delineavit Geo. Walker. 4to, London [1784].

* "No date is attached to this work; but the copy in the library of Mr. J. G. Jeffreys, with the use of which I have long been favoured, and which was originally in the possession of Dr. Turton, contains the manuscript date of May 1st, 1784. That this was the date of publication is rendered increasingly probable by the fact that the copy in the library of the British Museum, which formerly belonged to Sir Joseph Banks, contains a manuscript letter from Jacobs to Sir Joseph, written to accompany the two copies of the work that Walker sent to the worthy baronet. The letter is dated May 2nd, 1784. For this fact I am indebted to Dr. Gray, of the British Museum."

† Test. Minut. Rar., Introduction, p. v.

accordance with the binomial plan of Linnæus. These names were chiefly modifications of prominent terms selected from Walker's, or rather Jacob's, brief descriptions: for example, the *Nautilus subarcuatus geniculis exertis* of the latter became the *Nautilus subarcuatulus* of Adams. These facts would lead us to ascribe the names usually given to the more common British Foraminifera to Adams rather than to the authors of the 'Testacea Minuta Rariora;' but my kind friend Dr. Gray has called my attention to a note on p. 344 of Dillwyn's 'Catalogue of Recent Shells,' where, under the head of *Nautilus lobatulus*, the author observes, 'It first appeared with the present name in the "Essays on the Microscope;" and Adams there says he had obtained a manuscript corrected copy of the minute shells, to which Walker had added all the trivial names [which he has used].' 'This,' as Dr. Gray observes to me in a recent communication, 'sets the matter at rest why they are quoted as Walker's.'"

It is in the second, or Kanmacher's, edition of Adams's 'Essays on the Microscope*' that the binomial appellations are given to Walker's figures, or rather to some of them, which are faithfully copied in Kanmacher's 14th plate. In a note at page 633, Kanmacher says, "Being possessed of Mr. Jacob's own corrected copy of the work (Test. Min.), to which he has annexed the trivial names, I am thereby enabled to affix them to the several shells here enumerated." Kanmacher's observations (including an extract from a letter written by Sir J. Banks to Mr. Jacob) on the joint work of Walker, Boys, and Jacob, and on the study of minute shells, are well worth reading (p. 630, &c.).

The specimens examined and figured by Walker were obtained by Mr. Boys and himself from the shore-sands of Sandwich, Faversham, Sheppey, and the intervening coast; and amongst them we have some fossil Foraminifera† washed by the action of the sea and streams from the tertiary clays and sands of the respective neighbourhoods, and mixed with the recent shells in the mud and sands of the coast‡.

* Essays on the Microscope, by the late George Adams. The second edition, with considerable additions and improvements, by Frederick Kanmacher, F.L.S., 4to, London, 1798.

† Still more fossil specimens from these localities were afterwards figured and described by Col. Montagu, who worked over Mr. Boys's collection, which appears to have been increased by materials accumulated during several years subsequent to the time when Walker and Jacob had it in hand.

‡ This was remarked by one of us some years since (Quart. Journ. Geol. Soc. vol. viii. p. 267). Foraminifera from the Chalk also are in many places abundantly mixed with the sea-sand of the Kentish coast; and

(A. *a–e*). Walker, *Test. Min.* figs.* 1, 2, 3, 4, & 10. These are *Miliolæ*, of the Quinqueloculine type. Some are young forms, as figs. 2 and 10. Fig. 10 is the double primordial chamber of a carinate *Quinqueloculina*†. Fig. 2 represents a young striated shell‡ in a more advanced stage of growth than that shown by fig. 10. These forms, which are characteristically the young forms of the Quinqueloculine varieties of *Miliola*, have been named *Adelosina* by D'Orbigny.

Figs. 1 & 3 represent small specimens of *Q. Seminulum*§; fig. 3 is probably a flattish individual‖, broken through the middle¶. Although showing only three chambers (and insomuch Triloculine), fig. 4 (*Vermiculum subrotundum*, Montagu) is probably an undeveloped form of the common inflated *Q. Seminulum*, var. *secans***.

(B.) Fig. 5 is a specimen of the common *Polymorphina*††, of small growth. This is well known as *P. communis*, D'Orb. (with interminable degrees of size and shape; but the name *lactea* (Kanmacher, for Walker and Jacob) is an older appellation.

(C. *a–d.*) Fig. 6 is a well-formed *Lagena*‡‡, with strong riblets, and presenting one of the countless modifications of the costate ornament. This is the *Serpula* (*Lagena*) *sulcata* of Walker and Jacob (in Kanmacher's edition of Adams's 'Essays'); also the *L. striata* of Montagu. In quoting Kanmacher, Turton in his 'Linn.' misnamed this *Lagena* "Serpula Lagena," instead of *S.* (*L.*) *sulcata*. Montagu appears not to have referred to Kanmacher, but to have used Turton's list; and he supplied the trivial name "striata" from the description in the 'Test. Minut.,' whence also Jacob had previously taken the name *sulcata*, published by Kanmacher.

Prof. Williamson has hence been led to figure and describe as recent two fossil specimens of *Frondicularia* well known as belonging to the Chalk.

* The figures on the plates in Walker's work are numbered consecutively throughout.

† For the plan of growth of *Miliolæ*, see Parker, 'On some Indian Miliolitidæ,' Microsc. Transact. new ser. vol. vi. p. 53; and Williamson's Monogr. Recent Foram. p. xviii.

‡ "From Sandwich and Reculver; though not common."

§ Fig. 1 is referred with a doubt to this species by Walker and Jacob, who also observe, "It varies in size and shape, and is found in every portion of the sea-sand which hath been examined." It is the *Vermiculum intortum* of Montagu, who hesitates to place it with *M. Seminulum*.

‖ "From Sandwich; very rare."

¶ Montagu also intimates that it must have been a mutilated specimen.

** "In sand of all the different parts of the shore."

†† "From Sandwich; not common."

‡‡ "From Sandwich, Reculver, and Sheppey; very rare."

Fig. 9 is a smooth *Lagena**, less globose than that shown by fig. 6, and tapering gently to the neck.

Fig. 8 is a smooth short-necked *Lagena*†, or rather represents a specimen having no external, but an internal neck-tube,—a form known as *Entosolenia* (Ehrenberg). Fig. 7 represents the *Entosolenia marginata*‡, a compressed *Lagena* with intussuscepted apertural tube. The relations of the externally and the internally tube-necked *Lagenæ* are so close that we cannot regard them as forming two distinct specific types. To this opinion we strongly bent in the paper on the Norway Foraminifera§; and we feel far more convinced by subsequent observations.

For the reasons which guided us in the consideration of *Nodosariæ* (Ann. N. Hist. 3rd ser. vol. iii. pp. 476, 478) we regard *Lagena sulcata* as the type of the species. It exhibits essential features of form and ornament. Rib-patterns appear abundantly on these single-celled Foraminifers, and on their polythalamous congeners, the *Nodosariæ* and *Uvigerinæ*, and much less strongly on the *Polymorphinæ*, which are also related, but more particularly, to the Entosolenian group. The reticulate ornament, formed by minute transverse concentric ridges uniting the parallel ribs, or by sinuous riblets anastomosing with each other, is more specially a feature in the latter group, though traces of it are occasionally to be found on the typical *L. sulcata*. The marginate condition obtains both in Entosolenian and Ectosolenian forms. The extrusion and intrusion of the aperture-tube occur to an exceedingly variable extent, and are often combined. The modifications of this feature are too numerous to be here described. We may remark that both *Ectosolenia* and *Entosolenia* often have tubes at each end of the shell; and occasionally there is a second internal tube attached to the side of the interior, appearing as though the tube had been broken off and its fragment had become attached during life. The *Lagenæ* are occasionally elongate and spindle-shaped, with an aperture at each end; these slender individuals are sometimes bent. Professor Williamson figures the section of a double or twin specimen of *Entosolenia*, in which two individuals had grown off divergently from the primordial cell.

Prof. Williamson prefers the smooth form ‖ as a representative of the type, but objects to use as a specific name the term "lævis," expressive of the absence of ornamentation, inasmuch as, in this case, the varietal names, alluding to the ornament,

* "From Sandwich; very rare." † "From Sandwich; very rare."

‡ "From the Reculver; very rare."

§ Annals Nat. Hist. 1857, vol. xix.

‖ In our paper on the Norway Foraminifera (Ann. N. H. 1857, vol. xix. p. 278) we also took this as the type.

would appear contradictory; and he proposes "vulgaris" as the typical name. Taking *L. sulcata** as the characteristic form of the group, for the reasons already referred to, we think the varietal names *lævis*, *squamosa*, &c., whether expressing modification or absence of the ornament, will not be contradictory, and that a new specific name will not be required.

(D. *a*, *b*). Figs. 63 and 64 represent the common and well-known *Rotalia*† *Beccarii*, recognized as this species by Walker and Jacob. They make the following remarks: "The colour, while the fish is alive, is a fine pellucid crimson; when dead, is white. It is found alive on the *Fucus vesiculosus*, and is a very common shell on all the coast, and seems to be a universal littoral one, by the numbers found at Rimini and in the sand of the South Seas." The sinistral and dextral positions of the spire, which appeared to be an important feature to Walker and Jacob, are non-characteristic in Foraminifera‡.

(E.) Fig. 65 is the common *Polystomella crispa*. This also was recognized as a Linnæan species by Walker and Jacob. They observe: "The finest specimens are from Sheppey: not uncommon."

(F. *a*.) Fig. 66 is a variety of *Cristellaria Calcar*, rapidly enlarging in its whorls, ribbed, and keeled; approaching var. *Cassis*. This was from Sheppey, and most probably a fossil specimen from the London Clay of that island.

(F. *b*.) Fig. 67 is *Cristellaria Calcar*, orbicular and smooth. "From Sandwich and Seasalter: not common." We find it to be not uncommon in the recent state on the Kentish coast. Prof. Williamson mentions many other British localities for it. A large form occurs abundantly in the Tertiary sands and clays of Kent; and probably Montagu's specimen, 'Test. Brit. Suppl.' p. 75, pl. 18. figs. 7 & 8, "from the Boysian Collection," was one of these fossils.

(F. *c*.). Fig. 72 is a very young *Cristellaria*, probably of the Marginuline or crozier-like growth. "From Seasalter and Sandwich; very rare."

(F. *d*.) Fig. 73 is a well-developed, strongly ribbed, Marginu-

* Kanmacher's application of Jacob and Walker's MS. names should be strictly adhered to; and *sulcata* must be taken as the specific name.

Among Prof. Williamson's synonyma of his *Lagena vulgaris* a part only of Walker's diagnosis is quoted; *S.* (*L.*) *sulcata* is referred to "Adams, 1787," instead of Kanmacher, 1798; and Turton's *S. Lagena* (Linn. Syst. vol. iv. 1802, p. 609) is omitted.

† We agree with Prof. Williamson in discarding the name *Rosalina*, the differences once thought to exist between the two forms having very little value.

‡ Prof. Williamson has some good remarks on this point at p. 49 of his Monograph.

line *Cristellaria**, probably fossil. It was "from Sheppey Island: very rare."

(G. *a.*) Fig 68 appears to be a small *Nonionina*†, common on our shores, and of world-wide distribution, namely a delicate variety of the *N. asterisans* of Fichtel and Moll. Montagu, however, refers to this figure as being the same as that of his "Nautilus depressulus," which is a small *Cristellaria*. This mistake must have arisen from his finding his specimen mixed up with this little *Nonionina* in the Boysian collection. The many narrow, curved chambers, the rounded septal face, the sunken septal lines ("many depressed joints"), and the somewhat umbilicated spire, unmistakeably distinguish this from Montagu's.

(G. *b.*) Fig. 70 is another variety of *Nonionina asterisans*, with still more sunken joints or septal lines, and with a more open spire. It is common in some littoral sands. Walker found it at the Reculver,—"exceeding rare."

(H. *a.*) Fig. 69 is a common form of *Truncatulina lobatula*, having the outline of the cells uniform or flush; the septal lines being merely "furrowed." According to Walker, it was from Sandwich,—"not common."

Montagu (Test. Brit. Suppl. p. 78) refers to this figure when describing a little *Nonionina*; and Williamson (Monogr. p. 42) makes it a *Polystomella*. We believe that they must both be wrong, because in the specimen figured by Walker the two faces are decidedly unsymmetrical.

(H. *b.*) Fig. 71 represents the usual lobed form of *Truncatulina lobatula*‡, which is characteristically littoral. Walker found it at Whitstable,—"not common."

The more even-surfaced shell, fig. 69, is smaller than the last mentioned, and is generally found in deeper water. The raised, smooth, and nearly conical form, known as *T. refulgens*, D'Orb., inhabits still deeper zones. These three are few-celled varietal forms of *Planorbulina farcta*, Fichtel and Moll, sp., and usually attach themselves to sea-weeds and shells. Varied by their greater or less regularity of growth, and by the relative convexity of their cells, these varieties readily run into each other and into the Planorbuline (or Acervuline) forms, of which *P. farcta* is the type.

(I.) Fig. 74 is a not uncommon modification of the *Vaginulina Legumen* of the British coasts. "From Sandwich: exceeding

* For further remarks on *Cristellariæ*, see Ann. N. H. 1857, xix. p. 290.

† "From Reculver: very rare."

‡ In Ann. N. H. 1859, iii. p. 482, we have shown that the term *Serpula nautiloides*, formerly thought to have reference to *T. lobatula* (Ann. N. H. 1857, xix. p. 293), belongs to quite another animal.

rare," according to Walker. We may here remark that we retain "Vaginulina" as a subgeneric term, in preference to "Dentalina," used by Professor Williamson, because *Vaginulina* is the most perfect mean between the two extremes *Nodosaria* and *Cristellaria*; whereas *Dentalina* is as intimately connected with *Nodosaria* on the one hand, as *Marginulina* is with *Cristellaria* on the other. At the same time, we must repeat that there is no real divisional line existing between any of these forms.

(J.) Fig. 89, described by Walker and Jacob (p. 25) as "Echinus subrotundus planus lobatus. The colour opaque white. From Reculver; rare," is manifestly (from its minute size, faintly drawn spire, and peculiarly placed aperture) a common variety of *Globigerina bulloides*, D'Orb., which is found on our shores. Walker's fig. 89 has not been previously recognized (we believe) as representing a Foraminifer.

The opposite Table shows the species and varieties figured by Walker.

The Foraminifera figured and described in Montagu's 'Test. Brit.' and 'Supplement.'

Subsequent to Walker's work on the minute shells of the Kentish coast, little was done in England in the natural history of the Foraminifera until Colonel G. Montagu produced his 'Testacea Britannica*,' in 1803, and the 'Supplement†' in 1808. Walker's species, however, had received names in Kanmacher's second edition of G. Adams's 'Essays on the Microscope' (1798); and John Adams and other naturalists had noticed a few of the more common littoral species.

On the Continent several fossil forms, chiefly Nummulites, had been during this time noticed and figured by Tozzetti, Faujas, Fortis, and others; and Soldani had produced his gigantic Monograph on the fossil and recent Foraminifera and other minute shells of Tuscany. With the same date as that of the 'Test. Brit.', there was published at Vienna a handsome volume devoted to Foraminifera—the 'Testacea Microscopica,' &c., by Fichtel and Moll, containing good figures and careful descriptions. This work we hope to analyze in our next communication.

Professor Williamson has the following useful remarks on these works in the Introduction to his Monograph (p. vi.) :—

"The appearance of Montagu's 'Testacea Britannica' in 1803, and the 'Supplement' in 1808, marked a new era in the study

* Testacea Britannica; or, British Shells. Parts I. & II. 4to, Romsey and London, 1803. In the 'Bibliograph. Zool. et Geol.,' published by the Ray Society, the date of this work is misprinted "1803–1808."

† Supplement to the Testacea Britannica, with additional plates. 4to, Exeter and London, 1808.

Table of the Species and Varieties of Foraminifera figured in Walker's 'Testacea Minuta.'

	Walker and Jacob's MS. Names in Kanmacher's edition of Adams's 'Essays on the Microscope' (1798).				References to Walker's 'Test. Minut.'			Corrected Names.
	Page	Pl.	fig.		Page	Pl.	fig.	
A. *c.*	...	...	...	....	1	1	1	Miliola (Quinqueloculina) Seminulum, *L.*
A. *b.*	633	14	2	Serpula bicornis ...	1	1	2	„ „ „ (young).
A. *d.*	633	14	3	S. perforata	2	1	3	„ „ „
A. *e.*	...	...	...	....	2	1	4	„ „ „ var. subrotunda, *Montagu.*
B.	634	14	4	S. lactea	2	1	5	Polymorphina lactea, *Walker & Jacob**.
C. *a.*	634	14	5	S. (Lagena) sulcata .	2	1	6	Lagena sulcata, *W. & J.* (L. striata, *Montagu.*)
C. *d.*	...	...	...	....	2	1	7	L. (Entosolenia) marginata, *Mont.* } *Type*, Lagena sulcata, *W. & J.*
C. *c.*	...	...	...	....	3	1	8	L. (Entosolenia) globosa, *Mont.*
C. *b.*	...	...	...	....	3	1	9	L. sulcata, *W. & J.*, var. lævis, *Mont.*
A. *a.*	634	14	6	Serpula retorta	3	1	10	Miliola (Quinqueloculina) Seminulum, *L.* (young).
D. *a.*	640	14	29	Nautilus Beccarii ...	18	3	63	} Rotalia Beccarii, *L.*
D. *b.*	...	...	...	....	18	3	64	
E.	640	14	30	N. crispus	18	3	65	Polystomella crispa, *L.*
F. *a.*	641	14	31	N. Calcar	19	3	66	Cristellaria Calcar, *L.*, var. Cassis, *Fichtel & Moll.*
F. *b.*	641	14	32	N. lævigatulus	19	3	67	C. Calcar, *L.*, var. lævigatula, *W. & J.*
G. *a.*	641	14	33	N. depressulus	19	3	68	Nonionina asterisans, *F. & M.*, var. depressula, *W. & J.*
H. *a.*	641	14	34	N. umbilicatulus ...	19	3	69	Truncatulina lobatula, *W. & J.*, var. umbilicatula, *W. & J.*
G. *b.*	641	14	35	N. crassulus	20	3	70	Nonionina asterisans, *F. & M.*, var. crassula, *W. & J.* [*Type*, Planorbulina farcta, *F. & M.*]
H. *b.*	642	14	36	N. lobatulus	20	3	71	Truncatulina lobatula, *W. & J.* [*Type*, Planorbulina farcta, *F. & M.*]
F. *c.*	642	14	37	N. carinatulus	20	3	72	Cristellaria (young).
F. *d.*	642	14	38	N. subarcuatulus ...	20	3	73	C. (Marginulina) subarcuatula, *W. & J.* [*Type*, C. Calcar, *L.*]
I.	...	...	...	....	21	3	74	Nodosaria (Vaginulina) Legumen, *L.* [*Type*, N. Raphanus, *L.*]
J.	644	14	46	Echinus lobatulus...	25	3	89	Globigerina bulloides, *D'Orbigny*, var. lobatula, *W. & J.*

* According to Kanmacher; see above, p. 335.

of British Foraminifera. Not only were several new forms added to the list, but improved figures and more elaborate descriptions were substituted for the imperfect ones hitherto published. In the first of these publications the difficulty of defining the limits of specific variation obviously dawned upon the mind of the author; and in describing his *Vermiculum intortum* (*Miliolina Seminulum*) he distinctly states that this is so variable in its formation, that, without great attention, it might be formed into several species,—a warning that might have been received with advantage by many of Montagu's successors in the study of Foraminifera. Shortly after the appearance of Montagu's first volume, the publication of the 'Testacea Microscopica' of Fichtel and Moll indicated that these accurate observers had obtained further light respecting the variableness of many of the Foraminifera,—a fact especially demonstrated by their description of *Nautilus Calcar* (*Cristellaria Calcar*); but notwithstanding his previous experience, when publishing his 'Supplement,' Montagu was unable to follow these authors in their accurate determinations. 'If,' he remarks, speaking of the numerous forms of *N. Calcar* delineated by these writers, 'these can be admitted as the same species, we may bid defiance to specific definition.' Nevertheless Fichtel and Moll were in all probability right."

The 'Test. Brit.' (which consists of two parts continuously paged—Part I., with Introduction and pp. 1–292, and Part II. pp. 293–606) contains thirty short descriptions of specimens that, with few exceptions, were in "the Boysian Collection," and more than half of which had been already described and figured by Walker. Montagu gave figures of six previously undescribed forms, but does not appear to have personally examined all the Boysian specimens, having in some instances worked from drawings and notes received from Mr. Boys. In the 'Supplement,' five years afterwards, he described more fully eleven forms, refiguring most of them; and introduced, with figures of all but one, six that he had not previously noticed. By this time Montagu had had the opportunity of personally examining "the Boysian Collection," presented to him by Mr. Henry Boys, and which seems to have been increased by additions made from the coast-sands since Walker first had it in hand. This examination led Montagu to correct and improve some of his previous descriptions*; but at the same time, from some cause or other, he was evidently led into mistakes as to the identity of specimens already figured by Walker. Thus

* He had also been enabled to enlarge his knowledge of these minute shells by comparing his recent specimens with fossil Foraminifera brought from Italy by Messrs. Mead and Higginson.

Walker's "umbilicatulus," "depressulus," and "lævigatulus" are species or varieties different from those so named by Montagu. The difficulty of recognizing essential differences in minute and very similar forms, the mixing of specimens, or the shifting of labels (numerals) may probably account for these discrepancies.

In criticising Montagu's nomenclature of the Foraminifera, as well as in noticing Walker's figures, we frequently refer to Prof. Williamson's Monograph of the Recent British Foraminifera, the latest and best work on the subject. As the works of these three authors comprise the main bulk of all the published original researches on British Rhizopods, it has been especially necessary to keep Prof. Williamson's elaborate and well-illustrated Monograph in view. Besides the occasions we have of noting our agreement with many of his determinations, we have also incidentally to notice points of disagreement between his views and our own, without systematically corroborating or discussing all the species which he has enumerated. We hope, however, at some future time to compare notes with our highly valued brother-naturalist; and in the meantime we believe that he will be as ready to take into consideration the points of difference which we notice, as to recognize and be gratified by our general concurrence with the results of his long-continued and important researches.

Occasional references are also made by us to the works of Maton and Rackett, Turton, and others; also to names adopted by Lamarck and D'Orbigny. The two last-named authors will supply us with matter for future papers; and then we shall treat of the generic names borrowed from them for the species figured by Walker and Montagu.

It may be well to observe in this place that we wish our readers to remember that, although we protest against the adoption of the numerous published binomial appellations of known Foraminifera as *specific* names, yet we are quite cognizant of the general convenience, and sometimes of the necessity, of retaining the published names of varietal forms for use among zoologists, and still more especially among palæontologists.

(**A.** *a.*) Pl. 14. fig. 9, p. 522. "Vermiculum oblongum." This is a common Triloculine form of *Miliola,* belonging to the typical species, *M. Seminulum,* Linn., and has been conveniently designated *Triloculina oblonga* by D'Orbigny (Tabl. Céphal., Annales des Sc. Nat. vol. vii. p. 300, No. 16). Montagu collected his specimens at Salcombe Bay, Devonshire. It is of frequent occurrence on most shores.

(**A.** *b, c.*) P. 519. "Vermiculum bicorne" and "V. perforatum." See above, p. 341.

(A. *d.*) P. 520. "Vermiculum intortum." This is Walker's fig. 1. Montagu felt much hesitation in separating it from Linné's *S. Seminulum*.

(A. *e.*) P. 521. "Vermiculum subrotundum." See above, p. 336.

Maton and Reckett, in the 'Linnæan Transact.,' 1807, vol. viii. p. 245, referred *Vermiculum intortum*, Montagu, and *Serpula ovalis*, Adams (Linn. Trans. 1800, vol. v. p. 4. pl. 1. f. 28–30), to Linné's *Serpula Seminulum*. They also united Montagu's *Vermiculum bicorne* and *V. perforatum*, terming it *S. bicornis*. Further, they expressed their doubt whether *S. Seminulum*, *S. subrotunda*, *S. oblonga*, and *S. bicornis* ought not to be considered rather as varieties than as distinct species.

Prof. Williamson (Monogr. p. 84) refers *M. subrotunda*, Mont., to *M. trigonula*, Lam.; but in this determination we entirely differ from him.

(B.) P. 522. "Vermiculum lacteum." *Polymorphina lactea*. See p. 336.

(C. *a.*) P. 523. "Vermiculum striatum." *Serpula (Lagena) sulcata* of Walker and Jacob, according to Kanmacher. Montagu, by following Turton, missed the name applied by Jacob, and gave another. See p. 336.

(C. *b–d.*) Pp. 523 and 524. "Vermiculum globosum," "V. læve," and "V. marginatum." Montagu thus termed those *Lagenæ* which remained unnamed by Kanmacher.

(C. *e.*) Pl. 14. f. 3, p. 525. "Vermiculum perlucidum." A six-ribbed variety of *Lagena sulcata*, Walker. From Seasalter (Whitstable Bay).

(C. *f.*) Pl. 14. f. 2. p. 526. "Vermiculum squamosum." A reticulate and common variety of the globose Entosolenian *Lagenæ*. From Seasalter.

(D. *a.*) Pl. 6. f. 4, p. 197. "Nautilus Radicula." This is distinct from the specimen figured at pl. 14. f. 6, which is a *Clavulina* (see p. 350). Montagu evidently felt the difficulty of placing the two together. Fig. 4 represents a specimen from Sandwich; and, since it is described as being of an "opaque brown" colour, it was possibly a fossil specimen. This elegant smooth variety of *Nodosaria* is common in the London Clay, but wanting in our recent British fauna. The regularity of form and smoothness of surface vary indefinitely among the recent and fossil congeners of *N. Radicula*; and indeed, at page 86 of the Supplement, Montagu refers to these "numerous varieties."

(D. *b.*) Pl. 14. f. 4, p. 198. "Nautilus jugosus." A tapering and slightly curved form of *Nodosaria Raphanus*, with the septal lines constricted. This specimen was "received from Mr. Boys," and was probably derived from the Thanet Sands or the London

Clay. In the latter this form is abundant. It is the *Nodosaria obliqua*, Linn. sp., as Montagu thought. D'Orbigny's *Dentalina acuta* is an analogous variety.

(D. *c.*) Pl. 14. f. 5, p. 199. "Nautilus costatus." The figure shows a straight and few-ribbed variety of *Nodosaria Raphanus.* This also is most probably fossil.

(D. *d.*) Supplem. pl. 19. f. 2, p. 83. "*Nautilus costatus*, var." A fragment of a straight symmetrical *Nodosaria.* In describing this variety, Montagu correctly remarks that this form is "subject to very great variation." Probably fossil.

(D. *e.*) Pl. 14. f. 1, p. 525. "Vermiculum Urnæ." "Found in sand from Sheppey." Probably the first cell of a *Nodosaria* (from the London Clay of Sheppey), showing the fractured wall of the next or second cell, encircling the base of the conically-produced septal face. The opposite, or lower, projecting point is the usual terminal pricklet.

(D. *f.*) Pl. 6. f. 5, p. 198. "N. subarcuatus." One of the innumerable Dentaline modifications of *Nodosariæ.* Montagu mentions having seen a drawing of another variety. Both were from Sandwich. The "brown epidermis" may probably have been due to fossilization.

Several varieties of these delicate tapering shells abound in the Tertiary clays (the cliff-washings of which afforded Boys and Walker so many Foraminifera); and some occur recent on our coasts, though they are neither large nor plentiful. In the Mediterranean and elsewhere they abound on deep mud bottoms. Authors have noticed and figured hundreds of the varieties, recent and fossil, as distinct species. D'Orbigny's *Dentalina communis* (from the Adriatic, and fossil in the Chalk) has the chambers oblique and distinct, and is a good sub-type; but Lamarck's older name, *Nodosaria dentalina* (An. s. Vert. vii. p. 596, no. 2) is well adapted for this group. Montagu's specimen, above referred to, has the septal lines of its earlier segments unmarked, and the later chambers are globose.

Prof. Williamson has taken Montagu's "N. subarcuatus" as the type of the Dentaline group. In this we cannot agree; for we do not regard this shell as a good typical form. The well-grown specimens of *Dentalina communis* (*N. dentalina*) of the Adriatic and Mediterranean far better represent the characters of the slender tapering arcuate *Nodosariæ* furthest removed from *N. Raphanus.*

(D. *g.*) P. 197, and Supplem. pl. 19. f. 4 & 7, p. 82. "Nautilus rectus." At p. 197, *N. Legumen* is described under this name: but in the "Supplement" these forms are separately and correctly defined. Montagu's *N. rectus* is a thickish and nearly straight form of *Nodosaria dentalina*, very common in the Lon-

don Clay, whence the "opaque brown" specimen submitted by Boys to Montagu was probably derived. D'Orbigny has recognized Montagu's figured specimen as a variety of his *Dentalina communis* (Tabl. Céph., Ann. d. Sc. Nat. vii. p. 254, no. 35), which is the same as Lamarck's *N. dentalina*.

(D. *h*.) Suppl. pl. 19. f. 5, p. 86. "Nautilus spinulosus." A fragment of a pretty spinose Dentaline *Nodosaria*, very common in the London Clay. It passes, on one hand, losing its ornament, into *N. dentalina*; and, on the other, by means of finely costate forms, into *N. Raphanus*, the prickles being equivalent to undeveloped riblets, and often passing into regular costæ. D'Orbigny has re-named this variety *Dentalina Adolphina*, in his 'Foram. Bassin Vienne;' and *D. floscula*, D'Orb., *Nod. hispida*, D'Orb., and *Nod. aculeata*, D'Orb., are like varieties. The *D. spinescens* of Reuss is the same.

(D. *i*.) Supplem. pl. 19. f. 6, p. 82. "Nautilus Legumen." This is the recent *Nodosaria* (*Vaginulina*) *Legumen*, Linn. sp.

(D. *j*.) Suppl. pl. 30. f. 9, p. 87. "Nautilus linearis." A delicate Vaginuline modification of *Nodosaria*, intermediate between *Vaginulina Legumen*, Linn., and *V. Badenensis*, D'Orb. Montagu obtained his specimen from "the shell-bank near Dunbar, North Britain;" Prof. Williamson has received this shell from other British localities. A fragment from the Norwegian coast is figured in our paper, Annals N. H. 1857, vol. xix. pl. 11. fig. 2.

(E. *a*.) P. 191, and Supplem. pl. 18. f. 1, p. 78. "Nautilus umbilicatulus." Montagu refers to Walker's fig. 69 for this shell; but Walker's two aspects of the specimen show an unsymmetrical shell, like a *Truncatulina**. In Montagu's further description in the "Supplement," he describes specimens collected by himself from a Sabella ("in the Bay of Kingsbridge"); and his figure differs materially from Walker's, and represents a small variety of *Nonionina asterisans*, Fichtel and Moll, sp. It cannot be the *Polystomella*† *striatopunctata*, F. & M. sp., which Prof. Williamson has called *P. umbilicatula* (Monograph, p. 42),

* See above, p. 339.

† In the Ann. N. H. 1857, xix. p. 288, we referred this *P. striatopunctata* to *Nonionina*; but, in spite of its extreme similarity of form to the small *Nonioninæ*, we now adhere to Mr. Williamson's opinion of its being a *Polystomella*. We must, however, go further, and regard it as specifically the same as *P. crispa*.

We may here observe that the tribe of small *Nonioninæ* converging round *N. asterisans*, although conveniently considered as a subspecific group, yet in reality are essentially of the same specific type as that to which *Polystomella crispa* belongs. They may be said to be arrested or feebly developed conditions of the form in which a luxuriant growth of exogenous shell-matter symmetrically bridges over the septal sulci and the aperture, and otherwise thickens and ornaments the shell.

referring to Walker's fig. 69 (erroneously) and to Montagu's pl. 18. fig. 1, as the same form. Walker's fig. 68 (*Nonionina depressula*) is the variety nearest to Montagu's figured specimen.

Intending to take *Nonionina crassula* (Walker and Montagu) as the specific type, we have noticed under this name a little *Nonionina* from Norway, in the Ann. N. H. 1857, xix. p. 286; but we believe that the form described by Fichtel and Moll as *Nautilus asterisans* best represents the essential characters of the specific group to which *Non. depressula,* Walker, *Non. crassula,* Walker, *Non. umbilicatula,* Montagu, *Non. incrassata,* F. & M., and many other varieties belong. The Norwegian form above referred to will therefore stand with us as *Nonionina asterisans,* F. & M., var. *umbilicatula,* Mont.

(E. *b.*) P. 191, and Supplem. pl. 18. f. 2, p. 79. "Nautilus crassulus." This is the same as Walker's fig. 70, and is a variety of *Nonionina asterisans,* F. & M. sp., which is a form having an extreme variability of outline and of thickness. The septal lines may be flush with the chamber-walls, or sulcate, or limbate in many modifications. In this specimen from Reculver we have an open umbilicus and sulcate septal lines, both in greater degree than in the former variety, pl. 18. fig. 1.

Similar varieties of this *Nonionina* abound in shallow seas, and are among the few Foraminifera that live high up in estuarine waters and in salt-marshes. The Foraminifera represented by pl. 18. figs. 1–6, and fig. 9 in pl. 14 (*Nonionina umbilicatula, N. crassula, Rotalia inflata, R. Beccarii, Polystomella crispa,* and *Triloculina oblonga*) are the group especially affecting these habitats.

(F.) Supplem. pl. 18. f. 3, p. 81. "Nautilus inflatus." This is a *Rotalia* of a typical specific form (as already remarked by Williamson), and characteristic of a subgenus. This sandy-shelled *Rotalia,* exhibiting a structural condition rare, if not unique, among the genus, differs from its congeners so strikingly in this particular, and in its almost globigerine mode of growth, that we propose to refer it to a separate subgenus under the name *Trochammina**.

The species under notice, which has always an arenaceous shell, has its fullest development in shallow water, where it is sometimes very abundant. For instance, some of the clay from the Peterborough Fens yields it profusely. Montagu had it from Devon, and Prof. Williamson has found it elsewhere on our coasts; usually it is rare. It occurs also at Leghorn. In deeper water it is represented by attenuated varieties, ultimately becoming Spirilline. The contrary to this habit holds good with

* From τροχὸς, *rota*; and ἄμμος, *arena*.

Rotalia repanda, F. & M. sp., whose varieties are depauperated on shore, but found to be typically fine in abyssal dredgings.

(G.) Pp. 186, 187, and Supplem. pl. 18. f. 4 & 6, p. 74. "Nautilus Beccarii," and "N. Beccarii perversus." Dextral and sinistral forms of *Rotalia Beccarii*, L. (See above, p. 338.)

(H.*a.*) P. 515. "Serpula lobata." Fig. 71 of Walker (*Truncatulina lobatula*) is here referred to, also the *Serpula nautiloides* of Gmelin. The latter is a sessile form of *Lituola* (*Placopsilina*).

Maton and Rackett re-transferred this shell to the nautiloid group after Montagu had placed it among the *Serpulæ*.

(H. *b.*) Supplem. p. 160. "Serpula concamerata." According to the description given, this is a minute Rotalian form, and may belong to either of the chief sub-groups of the genus *Rotalia* (viz. *Calcarina*, *Rotalia* proper, *Planorbulina*, and *Trochammina*). Prof. Williamson (Monogr. p. 52) has used the name *Rotalina concamerata* as typically indicative of certain forms comprising *Rosalina globularis*, D'Orb., *Rotalina Boueana*, D'Orb. &c. It appears however, to us, that in Prof. Williamson's pl. 4, figs. 101–103 represent an ordinary specimen of *Rotalia repanda*, F. & M. (*R. Boueana* is the same form); and that figs. 104 and 105 represent *Rosalina globularis*, which is a variety of *Rotalia trochidiformis*, Lamarck.

In our paper on some Norwegian Foraminifera (Ann. N. H. 2 ser. vol. xix.), we have also misarranged some of these *Rotaliæ*, led by the extreme similarity (as to external form) of the great typical *R. repanda* (*op. cit.* pl. 10. fig. 22–24) to *R. vesicularis*, Lam., which is a flat variety of *R. trochidiformis*, whilst the smaller form (pl. 11. figs. 13, 14) is really a variety of *R. trochidiformis*, being the *R. globularis* of D'Orb., Modèles, No. 69 (not No. 66, as in 'Monogr.' p. 52).

Prof. Williamson gives no definite reason for his application of this name used by Montagu. We are still of opinion that Montagu in this case referred to some Planorbuline (or Truncatuline) form, as we indicated in Ann. N. H. 2 ser. vol. xix. p. 294, *note*.

(I.) P. 187, and Supplem. pl. 18. f. 5. "Nautilus crispus." The well-known *Polystomella crispa*, L.

(J. *a.*) P. 189, pl. 15. f. 4, and Supplem. p. 76. "Nautilus Calcar." A characteristic keeled specimen of *Cristellaria Calcar*, but not essentially distinct from those figured in pl. 18. figs. 7–9, nor from Walker's figs. 66 & 67. The *Nautilus rotatus* figured in Wood's Catal. and referred to *N. Calcar* by Maton and Rackett, is a different shell.

(J. *b.*) P. 188, and Supplem. pl. 18. f. 7 & 8, p. 75. "Nautilus lævigatulus." A large-sized "pale ferruginous brown" speci-

men of *Cristellaria Calcar* is figured in the 'Supplement' under this name, from the "Boysian Cabinet." In this variety the umbo has encroached upon the limbated septal lines; but there is nothing to render this variety essentially distinct from those shown in pl. 15. f. 4, and pl. 18. fig. 9. Without doubt this specimen, which has its last chamber broken, was fossil. It is the *C. Wetherellii*, Jones, Quart. Journ. Geol. Soc. vol. viii. p. 267.

The *N. lævigatulus* of Walker (fig. 67) is a recent typical *C. Calcar*. Montagu appears to have had some difficulty in recognizing Walker's specimen, though in the 'Supplement' (p. 75) he intimates that his *N. Calcar* and Walker's *N. lævigatulus* "have been generally confounded."

(J. *c.*) P. 190, and Supplem. pl. 18. f. 9, p. 78. "Nautilus depressulus." At p. 190, Walker's fig. 68 is referred to, and his description given, of a *Nonionina*; but in the 'Supplement' a small keelless *Cristellaria Calcar*, probably recent, is figured and described. This has no relation whatever with the *Nautilus depressulus* of Walker. (See above, p. 339.)

Those who have followed Montagu's nomenclature have been led into the same mistake; and we necessarily consider that in Prof. Williamson's 'Monograph,' p. 25, "Nautilus depressulus, Adams, 1798, N. depressulus, Turton, N. depressulus, Mont. Suppl. p. 78, N. depressulus, Pennant," &c., should be erased from the synonyma of *C. Calcar*.

Maton and Rackett gave the name of *N. rotatus* to Montagu's fig. 4. pl. 15. In Wood's 'Index Test.' (pl. 13. fig. 5) a variety of *Rotalia Partschiana*, D'Orb., is represented under Maton and Rackett's name. The lower face of this *Rotalia* (shown in the figure referred to) closely resembles a *Cristellaria*. Wood's "N. rotatus" should also, therefore, be removed from the synonyma of *C. Calcar*.

(J. *d.*) Suppl. pl. 19. f. 1, p. 80. "Nautilus subarcuatulus." The Marginuline form of *Cristellaria Calcar*. It was from "the Boysian cabinet;" and as this collection contained specimens from various parts of the Kentish coast, it is quite probable that we have here a fossil shell from the Thanet Sands, in which this form is not uncommon*. In the 'Test. Brit.,' p. 196, "N. subarcuatulus" is placed as a synonym under "N. Semilituus."

(J. *e.*) P. 196, and Suppl. pl. 19. f. 3. p. 80. "Nautilus Semilituus." At p. 196, Walker's fig. 73 is referred to, and his description of *N. subarcuatulus* given under the name of "N. Semilituus, *Gmel.*," which is a misnomer, as mentioned in Ann. N. H. 1859, iii. p. 480. In the 'Supplement,' however, a different shell

* Quart. Journ. Geol. Soc. vol. viii. p. 267.

is described under this name, similarly misapplied. This is an interesting Marginuline variety of *Cristellaria Calcar* with ornamented septal lines, which is remarkably abundant and of large size in the London Clay*. We have here doubtless a specimen from that source. The pinched-in youngest chamber (taking on, as it were, a Dentaline character) frequently occurs in this fossil variety. San Domingo has a similar, but smaller, variety in its Tertiary clays; and a still more minute form is found in the clays of the English Oolites. Montagu's opinion that this is related to the crozier-shell (*Peneroplis planatus*) figured by Plancus is quite erroneous. (See above.)

Maton and Rackett followed Montagu in mixing "semilituus" with "subarcuatulus" (Linn. Trans. vol. viii. p. 118), and in similar mistakes. So also did Dillwyn in his 'Descriptive Catalogue of Recent Shells,' 1817, as well as Turton, Pennant, Fleming, &c.

(J. *f.*) Supplem. p. 80. "Nautilus bicarinatus." Described as being more arcuate than "N. subarcuatus, tab. 6. f. 5," rounded posteriorly, and furnished with two longitudinal ribs, "one along the arc, and another on the opposite side." From Sandwich.

Prof. Williamson has placed this among the synonyma of *Cristellaria subarcuatula* (Monogr. p. 29); and is most probably right in thus regarding it as a narrow Marginuline *Cristellaria*.

(J. *g.*) P. 195. "Nautilus carinatulus." Young of *Cristellaria Calcar*.

(K.) P. 197, pl. 14. f. 6. "Nautilus Radicula." This is the *Clavulina communis* of D'Orbigny, which is a dimorphous form of *Verneuilina tricarinata*, D'Orb.; that is, the trihedral arrangement characteristic of *Verneuilina* proper becomes soon replaced by a single series of chambers. Montagu, in his description (p. 198), refers to all the characters peculiar to this form, excepting its roughness of surface. He evidently had in hand specimens both of the form under notice and the very similarly shaped *Nodosaria Radicula*, which differs in its aperture and its terminal point, as he has noticed. From Sandwich. It is the *Nodosaria rustica*, Jones, Morris's 'Catal. Brit. Foss.' 1854, p. 38, and is very common in the London Clay. We have not met with it recent on the British coast, but abundantly in the Mediterranean.

* The *Marginulina Wetherellii*, Jones, Morris's Catalogue Brit. Foss. 1854, p. 37.

Table of the Corrected Nomenclature of the Foraminifera figured and described in the 'Testacea Britannica' *and* 'Supplement.'

	Montagu's Names.	Dates of new Names given by Montagu.	Corrected Names.	
A. *a.*	Vermiculum oblongum	1803	Miliola (Triloculina) oblonga, *Mont.* [*Type,* M. Seminulum, *L.*]	
A. *b.*	V. bicorne	......	M. Seminulum, *L.* (young).	
A. *c.*	V. perforatum	......	M. Seminulum, *L.*	
A. *d.*	V. intortum	1803	M. Seminulum, *L.*	
A. *e.*	V. subrotundum	1803	M. Seminulum, *L.*, var. subrotunda, *Mont.*	
A. *f.*	V. retortum	......	M. Seminulum, *L.* (young).	
B.	V. lacteum	......	Polymorphina lactea, *Walker and Jacob.*	
C. *a.*	V. striatum	1803	Lagena sulcata, *W. & J.*	*Type,* Lagena sulcata, *W. & J.* (C. *a.*–C. *d.*)
C. *b.*	V. globosum	1803	L. (Entosolenia) globosa, *Mont.*	
C. *c.*	V. læve	1803	L. sulcata, *W. & J.*, var. lævis, *Mont.*	
C. *d.*	V. marginatum	1803	L. (Entosolenia) marginata, *Mont.*	
D. *a.*	Nautilus Radicula......	......	Nodosaria Radicula, *L.*	*Type,* Nodosaria Raphanus, *L.* (D. *a.*–D. *j.*)
D. *b.*	N. jugosus..............	1803	N. Raphanus, *L.*, var. obliqua, *L.*	
D. *c.*	N. costatus	1803	N. Raphanus, *L.*, var. costata, *Mont.*	
D. *d.*	N. costatus, var.	1808	N. Raphanus, *L.*, var. Raphanistrum, *L.*	
D. *e.*	Vermiculum Urnæ ...	1803	Nodosaria (fragment).	
D. *f.*	Nautilus subarcuatus..	1803	Nodosaria dentalina, *Lam.*, var. subarcuata, *Mont.*	
D. *g.*	N. rectus	1803	N. dentalina, *Lam.*, var. recta, *Mont.*	
D. *h.*	N. spinulosus	1808	N. dentalina, *Lam.* var. spinulosa, *Mont.*	
D. *i.*	N. Legumen	......	N. (Vaginulina) Legumen, *L.*	
D. *j.*	N. linearis	1808	N. (Vaginulina) Legumen, *L.*, var. linearis, *Mont.*	
E. *a.*	N. umbilicatulus * ...	1808	Nonionina asterisans, *Fichtel & Moll*, var. umbilicatula, *Mont.*	
E. *b.*	N. crassulus	......	N. asterisans, *F. & M.*, var. crassula, *W. & J.*	
F.	N. inflatus..............	1808	Rotalia (Trochammina) inflata, *Mont.*	
G.	N. Beccarii .... / N. Beccarii perversus		Rotalia Beccarii, *L.*	
H. *a.*	Serpula lobata	......	Truncatulina lobatula, *W. & J.*	*Type,* Planorbulina farcta, *F. & M.* (H. *a.*–H. *b.*)
H. *b.*	S. concamerata	1808	Planorbulina? concamerata, *Mont.*	
I.	Nautilus crispus	......	Polystomella crispa, *L.*	
J. *a.*, J. *b.*, J. *c.*	N. Calcar / N. lævigatulus † / N. depressulus ‡ ..	......	Cristellaria Calcar, *L.*	
J. *d.*	N. subarcuatulus	....	C. Calcar, *L.*, var. subarcuatula, *W. & J.*	
J. *e.*	N. Semilituus §......	1808	C. Calcar, *L.*, var. Semilituus, *Montagu.*	
J. *f.*	N. bicarinatus	1808	C. Calcar, *L.*, var. bicarinata, *Mont.*	
J. *g.*	N. carinatulus	....	C. Calcar, *L.* (young).	
K.	N. Radicula (Pl. 14.. f. 6).	....	Verneuilina (Clavulina) communis, *D'Orb.* [*Type,* V. tricarinata, *D'Orb.*]	

* Walker's "umbilicatulus" is a *Truncatulina.* Montagu's figured specimen is decidedly a *Nonionina.*

† This name was given by Walker and Jacob to a smooth *Cristellaria Calcar,* of the typical form. Montagu's specimen is of larger growth, and umbonate, but scarcely requires a varietal name.

‡ The term "depressulus" is applied by Walker and Jacob to a *Nonionina.* Montagu's figured specimen is a true *Cristellaria Calcar.*

§ Not the "Semilituus" of Linnæus. See p. 349.

XXXVI.—*List of Coleoptera received from Old Calabar, on the West Coast of Africa.* By ANDREW MURRAY, Edinburgh.

[Continued from p. 123.]

Sphæridiidæ.

CYCLONOTUM, Erich.

1. *C. Mulsanti*, mihi.

Nigrum, nitidum, convexum, subtilissime punctatum. Elytris lateribus fortiter declivis, versus apicem repansis, decem-punctato-striatis, striis postice profundioribus; interstitiis sine punctis majoribus, stria suturali scutellum attingente, et ceteris profundiore, striis sextis et septimis haud marginem attingentibus, ceteris utrinque inclusis. Pedibus piceis.

Long. 2¼ lin., lat. 1½ lin.

Shining black, convex, very finely punctate. Head very smooth, with the faintest trace of a lowering of the surface on each side of the middle of the front before the eyes. Thorax deeply emarginate in front, with the anterior angles projecting; sides with margins slightly edged, and somewhat rounded in to the posterior angles. Scutellum moderate. Elytra with ten punctate striæ, which are deepest at the apex; the interstices are not impressed with larger punctures in addition to those of the general surface; the 6th and 7th do not reach the apex, but are embraced by the remainder on each side; the sutural stria, which is deepest, reaches the scutellum; the sides of the elytra decline sharply, so as to be nearly vertical, and the margin, particularly at the apex, is repanded almost like a hollow shelf. The legs are piceous.

I have named this species in honour of my esteemed friend M. Mulsant of Lyons, who first pointed out characters for the distinction of the species of this genus in his Monograph of it in the 7th volume of the 'Annals of the Society of Agriculture of Lyons.'

SPHÆRIDIUM, Fab.

1. *S. Senegalense*, Casteln. vol. ii. p. 61.

Nigrum, nitidum, orbiculare, convexum, subtilissime et dense punctatum, partibus oris, thoracis et elytrorum marginibus atque suturæ apice flavo-testaceis; elytrorum disco macula rufa obscura vix perspicua instructo; subtus obscurum, nigrum, pubescens; pedibus glabris flavo-testaceis, femoribus nigro-fasciatis.

Long. 1⅛ lin., lat. 1 lin.

Castelnau's description omits the scarcely visible red spot on the disk of the elytra, and describes the apex of the suture as

having a yellow spot common to both, whereas it is merely the yellow margin of the elytra continued round to the apex and up the suture for a short distance. He does not notice the black band on the thighs; but as this is not well marked on the anterior thighs, it may have escaped him. I have no doubt it is the same species as his; and these discrepancies may be accounted for by the shortness of his description. I do not think we can refer them to variableness in the species, for it appears to be more constant than the other species of the genus, all my specimens being alike; and I have had many through my hands.

Paussidæ.

Paussus, Linn.

1. *P. Murraii*, Westw. Journ. Linn. Soc. vol. i. p. 74 (1857).

Prothorace bipartito clavaque antennarum postice excavata; piceo-rufus sub lente creberrime punctatus; capite inter oculos transverse elevato et in medio fossulis duabus minimis transversis impresso, angulis posticis parteque postica prothoracis extus porrectis et fere latitudine elytrorum, podice setis longis marginato.
Long. 3 lin., lat. 1 lin.

Histeridæ.

Hololepta, Payk.

1. *H. arcifera*, Mars., Ann. d. l. Soc. Ent. d. France, 3 sér. vol. i. p. 159.

Oblongo-ovata, complanata, nigra, nitida; fronte æquali; pronoto stria marginali angulata; elytris margine inflexo lævi, stria subhumerali abbreviata, tribus dorsalibus obliquis, secunda appendiculata; propygidio punctis sparsis, duabusque striis oppositis arcuatis cincto; pygidio punctatissimo.
Long. 4½ lin., lat. 2 lin.

Not having previously seen the *H. arcifera* in nature, I cannot speak positively as to my species being it; but the description accords in every respect with that given of that species by M. de Marseul, with the exception of the size, mine appearing to be nearly a third larger.

Macrosternus, Mars.

1. *M. Lafertei*, Mars. Ann. d. l. Soc. Ent. d. France, 3 sér. vol. i. p. 243.

Latius ovatus, valde complanatus, nitidus, supra nigro-cæruleus; fronte concava, stria transversa nulla; pronoto lateribus punc-

tulato, stria marginali interrupta; elytris stria utraque subhumerali integra, dorsali prima integra, secunda antice abbreviata, tertia late interrupta; pygidio punctato utrinque foveolato, tibiis anticis quadridentatis.

Long. $3\frac{1}{4}$ lin., lat. $1\frac{3}{4}$–2 lin.

PLACODES, Erich.

1. *P. Senegalensis*, Payk, Mon. Hist. 13. 5, pl. 4. 5 (1811).

Ovalis, parum convexus, niger, nitidus; fronte impressa, stria sinuata integra; pronoto stria marginali tenui haud interrupta, laterali valida utrinque uncinata; elytris margine inflexo punctato, duabus striis, interna ad suturam prolongata, subhumerali externa postice, interna antice abbreviatis, dorsalibus 1–3 integris, ceteris apicalibus punctatis; propygidio bifoveolato pygidioque punctatis.

Long. 7 lin., lat. $3\frac{1}{2}$ lin.

PLATYSOMA, Leach.

1. *P. Murrayi*, Mars., Ann. d. l. Soc. Ent. d. France, 3 sér. vol. v. p. 403.

Oblongo-ovatum, depressum, nigrum, nitidum; fronte plana, stria transversa integra, pronoto stria laterali haud interrupta; elytris striis dorsalibus 1–3 integris, quarta dimidiata; pygidio marginato, ocellato-punctato; mesosterno sinuato marginatoque; tibiis anticis 4-dentatis, intermediis 4-, posticis 3-spinosis.

Long. 4 lin., lat. $1\frac{3}{4}$ lin.

PACHYCRÆRUS, Mars.

1. *P. cyanescens*, Mars., Ann. d. l. Soc. Ent. d. France, 3 sér. vol. i. p. 458.

Ovalis, supra parum convexus, cæruleus seu viridis metallicus, nitidus; antennis pedibusque rufo-brunneis; clypeo impresso a fronte distincto stria integra, pronoto lateribus fortius punctato, stria marginali interrupta; elytris striis 1–3 dorsalibus integris, 4ª, 5ª, suturali et subhumerali externa dimidiatis; mesosterno antice marginato.

Long. 2–$2\frac{1}{4}$ lin., lat. 1–$1\frac{1}{8}$ lin.

CONTIPUS, Marseuil.

1. *C. didymostriatus*, Mars., Ann. d. l. Soc. Ent. d. France, 3 sér. vol. i. p. 546.

Ovatus, convexus, niger, nitidus, mandibulis bidentatis margina-

tis; fronte stria semicirculari integra; pronoto striis tenuibus, marginali integra, 2 lateralibus ad angulum anticum evanescentibus alterutra in medio redintegrata; elytris striis didymis, suturali, 5 dorsalibus subhumeralique interna integris, externa abbreviata; tibiis anticis tridentatis.

Long. 5 lin., lat. 3½ lin.

HISTER, Linn.

1. *H. major*, Linn., Mars., Ann. d. l. Soc. Ent. d. France, 3 sér. vol. ii. p. 173.

Ovato-subquadratus, convexiusculus, niger, nitidus; fronte lata, stria sinuata integra, labro inciso; pronoto fulvo longius cincto, striis lateralibus integris pone oculos interruptis; elytris margine inflexo bisulcato, subhumerali interna et 1–3 dorsalibus integris, ceteris brevibus seu obsoletis; pygidio dense punctato; prosterno lobo brevi acuminato; tibiis anticis 3-dentatis, posticis tuberculato-longispinosis.

Long. 7 lin., lat. 4 lin.

2. *H. Calabaricus*, Mars., Ann. d. l. Soc. Ent. d. France, 3 sér. vol. v. p. 415.

Ovalis, parum convexus, niger, nitidus, antennis pedibusque brunneis; fronte plana stria semicirculari subrecta, mandibulis canaliculatis; pronoto stria laterali externa brevi, interna integra; elytris fossa subhumerali lævi bisulcata, stria subhumerali interna ad humerum producta, 1–3 dorsalibus integris, 4–5 apicalibus, suturali dimidiata; propygidio pygidioque basi parce punctatis, utrinque foveolatis; mesosterno emarginato stria integra; tibiis anticis tridentatis, posticis dense biseriatim spinosis.

Long. 3½–2½ lin., lat. 2⅓–1¾ lin.

This species varies greatly in size, as may be seen from the above dimensions.

3. *H. Loandæ*, Mars., Ann. d. l. Soc. Ent. d. France, 3 sér. vol. ii. p. 236.

Oblongo-ovatus, subconvexus, niger, nitidus; antennis pedibusque rufo-brunneis; fronte impressa, stria retrorsum angulata; mandibulis bidentatis, canaliculatis; pronoto stria laterali interna haud interrupta, externa brevi; elytris fovea marginali 1-sulcata, striis dorsalibus 1–3 integris, 4ª interrupta, 5ª abbreviata, suturali dimidiata; propygidio bifoveolato pygidioque parce punctatis; mesosterno recto, marginato; tibiis anticis tridentatis, posticis biseriatim multispinosis.

Long. 2¼ lin., lat. 1¼ lin.

COELOCRAERA, Marseul.

1. *C. Costifera*, Mars., Ann. d. l. Soc. Ent. d. France, 3 sér. vol. v. p. 430.

Ovalis, convexa, nitida, nigra, ore antennis pedibusque fusco-ferrugineis; fronte punctulata, foveolata marginataque; pronoto rugose punctato, margine laterali elevato, ad angulum bifoveolato; elytris sutura, margine, externa sextaque costis integris, margine inflexo bisulcato; propygidio pygidioque dense punctulatis; metasterno in medio sulcato primoque ventris segmento grosse punctatis; tibiis anticis latis extus multidenticulatis, posticis apicem versus parce spinosis.
Long. 1⅓ lin., lat. ⅔ lin.

TRIBALUS, Leconte.

1. *T. agrestis*, Mars., Ann. d. l. Soc. Ent. d. France, 3 sér. vol. iii. p. 155.

Orbicularis, convexus, niger, nitidus; antennis pedibusque ferrugineis; fronte concava, puncticulata; pronoto punctis parcis et tenuibus, stria marginali interrupta; elytris margine inflexo, bistriato, 2 striis subhumeralibus integris, dorsali unica media brevi, obsoleta, grosse et raro punctatis.
Long. 1⅓ lin., lat. 1 lin.

NITIDULIDÆ.

Carpophilidæ.

BRACHYPEPLUS, Erich.

1. *B. rubidus*, mihi.

Nitidus, sat latus et depressus, læte rufo-ferrugineus, capite elytrorumque apice nigris; capite punctato, antice medio leviter elevato. Thorace lato, punctato, postice medio bi-impresso, et angulis posticis excavatis. Scutello lato, fere rotundato. Elytris plus quam sesqui thorace longioribus, rugose punctato-striatis, striis haud apicem et marginem attingentibus, interstitiis leviter, apice et margine dense et rugose punctatis. Abdomine quinque segmentorum composito, primis duobus brevibus, ceteris longioribus, ultimo longissimo, supra quatuor segmentis solum aspectabilibus, aciculariter punctatis, marginatis, apice ultimi segmenti nigricante. Pedibus punctatis; femoribus subtus fere lævibus.
Long. 3½ lin., lat. 1 lin.

Shining, rather broad and much depressed; of a clear ferruginous red colour, except the head and apical half of the elytra, which are black, and the extreme point of the last segment of the abdomen, which is blackish. Head punctate, impressed on

each side in front, the impressions meeting between the eyes so as to leave a slight elevation like a flat nose, broadest in front; tips of the mandibles dark. Thorax broad, punctate, with the margins edged, bi-impressed on each side of the middle of the base; base slightly emarginate, middle portion straight, and with a slight tendency to project backwards, as in *Lebia*, and the posterior angles curved very slightly backwards; within the posterior angles is an elongated fovea or flattened hollow extending nearly halfway up along the margin. Scutellum broad, very nearly rounded, so as to look like a small segment of a circle; but the rounding is not quite perfect; it might be resolved into a five-sided figure with the angles rounded, of which the base occupies the anterior side. Elytra not quite twice the length of the thorax, but very nearly so, roughly punctate-striate, the striæ not reaching the apex nor the margin, both of which are closely and rugosely punctate; the interstices lightly punctate; the sutural striæ deepest on each side of the suture near the scutellum, and there closely punctate; the sides decline suddenly and nearly vertically, and there is a high-raised sharp edge. Abdomen with five segments, of which the first two are short and less firm in texture than the rest, the two next longer and equal to each other, and the last longest; above, the four last segments only are seen*; the three last are strongly acicularly punctate, and have a raised elevation a short space within the side, and extending across the base of the segment, making a short, projecting, more raised sort of tooth or angle at its marginal angle or termination; the second appears scarcely punctate, and this elevation is wanting in it. Under side and legs punctate, middle of abdominal segments and under side of thighs nearly smooth.

2. *B. niger*, mihi.

Precedenti valde affinis, sed major, niger et ubique magis fortiter punctatus.

Long. 4 lin., lat. 1⅜ lin.

Very closely allied to the preceding, but larger, wholly black, and with the punctation throughout coarser, and every character somewhat exaggerated or better defined.

I have hesitated whether to give this as a variety of the preceding or as a different species, but have come to the conclusion that it is to be viewed as distinct. I have received only two specimens of each; the characters, such as they are, are constant in both; and although I can find no better nor more

* It is possible that in life only the three last are seen; they are of a firmer texture, are punctate, and have the raised margin. It is therefore probably due to the relaxation of the connecting tissues, caused by my specimens having come home in spirits, that the second segment is partially seen from above in them.

distinguishing characters than those above given, still there is something in the look of the two which satisfies me that they are not the same. This sort of *primâ facie* evidence is often as convincing to an entomological eye as more defined and less empirical characters.

[To be continued.]

XXXVII.—*Additional Observations upon the Genera* Aptandra, Cathedra, Liriosma, Leretia, Poraqueiba, *and* Emmotum. By John Miers, F.R.S., F.L.S., &c.

Aptandra.

In completing the drawing to illustrate this genus, as described in this work (2nd ser. vii. 201), I have been able to add the details since obtained of the structure of its fruit and seed. This information, which fixes beyond doubt the position of *Aptandra* in the system, is derived from the analysis of the only fruit that accompanied a specimen of the *Heisteria tubicina* of Pöppig, which I received from Mr. Spruce. This plant is described by Pöppig in his 'Nov. Gen.' iii. 35, and is figured by him in plate 241, but only from immature fruit. We have satisfactory proof that it really belongs to *Aptandra* by the presence of an ovary in the same specimen, which is somewhat advanced in growth, and around the style of which the peculiar monadelphous staminal tube still remains, which is precisely similar to that I have shown in *Aptandra Spruceana*. The calyx, which in the flower is barely a line long, in the fruit grows to a very large size, becoming campanular with an entire spreading mouth, and it half envelopes the dry globular drupe, which is nearly an inch in diameter. Its pericarp is smooth, coriaceous, indehiscent, half a line in thickness, unilocular, and monospermous: the nucleus, in this instance, was greatly shrivelled, and in consequence much corrugated, and was covered with mildew, so that the nature of its decayed seminal envelopes could not be ascertained: a firm integument adhered closely to the pericarp, which appeared to me to be the external tunic of the seed rather than of the endocarp; but of this I cannot be sure: the nucleus adhered to the bottom of the cell by a round cicatrix, which appears to be the remnant of the free central placenta, upon which the ovules are attached in the floral ovary. The nucleus consisted of a homogeneous fleshy substance, which, after being well macerated and cut open transversely, showed no signs of any embryo; but in its centre was a large vacuity, the sides of which were pressed together by the shrinking of the mass: this vacuity presented a very polished surface; and from it several rays branched towards the circumference, leaving so many fleshy

wedges between the radiating spaces; near the summit these spaces terminated in one point, and in the solid part above this I discovered with some difficulty a very minute embryo, about half a line in diameter, consisting of two distinct, orbicular, flat, foliaceous cotyledons, with a notch on the margin for the insertion of the radicle, which was unfortunately lost in its extraction; but the polished indentation of the entire embryo, left in the substance of the albumen, indicated its shape and relative size in regard to the cotyledons. The evidence of this structure is therefore nearly complete. In the diminutive size of the embryo, imbedded in the summit of the albumen, this structure quite agrees with that of *Heisteria* and other genera of the *Olacaceæ*; and it may be further remarked that I have observed in the albumen of *Heisteria* and *Liriosma* a constant large vacant space, running from its base up its centre, and terminating in the more solid part below the summit, in which the small embryo is imbedded.

From the structure of the ovary, fruit, and seed, combined with other characters, it is manifest that *Aptandra* is nearly allied to the *Olacaceæ*, agreeing with that order in the form and æstivation of the calyx and petals. The singular enlargement of the calyx, which ultimately half envelopes the fruit, occurs in a very similar manner in *Olax*, *Heisteria*, and some other genera; but *Aptandra* is very distinct from every genus of that family in the remarkable confluence of the stamens into a long, thick, monadelphous tube, which embraces the style, and bears a number of extrorse anther-cells, adnate below its summit, just as in *Canella*, but which burst by the deflection of their outer valves, as in *Diclidanthera*.

This striking peculiarity might well claim the right of *Aptandra* to be the type of a distinct family allied to *Olacaceæ*; but I will not venture to propose it until other analogous genera are discovered: in the meantime it may remain as a suborder of that family, bearing the name of *Aptandreæ*.

To the generic characters of *Aptandra*, as before given (*loc. cit.* p. 201), we may therefore now add:—

Drupa magna, sicca, globosa, calyce persistente aucto cupulari laxe semicincta, *pericarpio* coriaceo indehiscente, 1-locularis, 1-sperma. *Semen* imo loculi affixum; *integumenta* ignota; *albumen* copiosum, carnosum, a basi ultra medium radiatim excavatum; *embryo* parvus, in illo summum versus sepultus, *cotyledonibus* orbicularibus, valde foliaceis, *radicula* brevi tereti supera 4-plo longioribus.

1. *Aptandra Spruceana*, loc. cit. vii. 202; Contrib. Bot. i. 3. tab. 1.

2. *Aptandra tubicina*, Bth. MSS.—Heisteria tubicina, *Pöp. Nov. Gen.* iii. 35. tab. 241;—foliis ellipticis, apice repente lineari-attenuatis, utrinque glabris, subtus ferrugineo-punctulatis, rachi nervisque anastomosantibus lævibus et rubellis, venis valde reticulatis; paniculis axillaribus, petiolo 4-plo longioribus, folio 7-plo brevioribus, pedicellis in fructu elongatis et incrassatis, in flore capillaribus; drupa globosa, calyce aucto laxe campanulato semi-inclusa.—Prope Panurè, Rio Uaupès, in Brasilia Septentr. (Spruce, 2741).

This is described as a short tree with lax branches; the axils are about 1½ inch apart; the leaves are 5½ inches long and 2 inches wide, upon a petiole 3 lines in length. The inflorescence is about ¾ inch long; the pedicels, which are capillary in flower, become thickened in fruit, especially towards their summit, and are upwards of an inch in length; the antheriferous tube, which I have represented in the drawing, exactly resembles that of the preceding species. The fruit is described in a preceding page.

3. *Aptandra Benthamiana*, n. sp.;—ramulis fuscis, angulatis; foliis ellipticis, versus summum gradatim angustioribus, apice angusto et rotundato, utrinque opacis, lurido-fuscescentibus, coriaceis, crassiusculis, nervis omnino immersis et vix distinguendis, margine undulato incrassato haud reflexo; paniculis in apicibus ramorum axillaribus, late ramosis, folio dimidio brevioribus; floribus parvulis, numerosis, pedicellis longissimis, capillaribus.—Prope San Carlos, Rio Negro, Brasilia Septentr. (Spruce, 3000).

Its leaves are 3 inches long and 1 inch broad, on a terete petiole 5 lines in length; the inflorescence is 1 inch long, 1½ inch broad, the capillary pedicels measuring 6 lines.

4. *Aptandra liriosmoides*, Spruce MSS., n. sp.;—foliis oblongis vel lanceolato-oblongis, imo obtusis, apice subattenuatis, obtusiusculis, et mucronulatis, glaberrimis, superne opacis, fusco-viridibus, inferne e punctulis numerosissimis cinereo-albescentibus, margine ferrugineo; nervis sese intra marginem arcuatis, tenuiculis, utrinque parce prominulis, rachi superne sulcato et albido, subtus prominente; paniculis late ramosissimis, folio tertio brevioribus; floribus parvulis, pedicellis capillaribus.—Prope Panurè, Rio Uaupès, Brasilia Septentr. (Spruce).

The axils of the branches are shorter than in the other species, being from ¼ to ¾ inch apart; the leaves are 2½ inches long and 11–12 lines broad, on a petiole 3 lines in length:

the inflorescence is ¾ inch long, spreading to an inch in breadth; the delicate pedicels are 7 lines long, the flowers in bud being 1¼ line in length.

Cathedra.

This genus has been described in a former volume (2nd ser. vii. 452); and the *Diplocrater* of Mr. Bentham (Kew Journ. Bot. iii. 367) does not appear to me to differ from it. Throughout the *Olacaceæ* there is a general disposition to a vast increment of the calyx, as in *Olax, Heisteria*, and *Liriosma*; in *Schöpfia* it is the disk that enlarges and becomes adnate to the fruit; but in *Cathedra* not only a considerable growth takes place in both the calyx and the disk, but generally one, and sometimes two of the cupuliform bracts, at first scarcely distinguishable, suddenly swell rapidly after the fall of the corolla, and the growing ovarium thus becomes surrounded by 3 or 4 distinct free cups, which are more or less concentric or superimposed. The ripe fruit is not known; but I have represented * the appearance of these disks when the ovary has attained ten times the size it had at the period of the fall of the corolla. I now add the details of two other species from Spruce's collections:—

1. *Cathedra rubricaulis*, nob., huj. op. 2 ser. vii. 458; Contrib. Bot. i. 15. pl. 2.—Corcovado, Rio de Janeiro.

2. *Cathedra Gardneriana*, nob., loc. cit.

3. *Cathedra acuminata*.—Diplocrater acuminata, *Benth. loc. cit.* p. 367;—ramis glabris, striatellis, ramulis floriferis virgatis, fusco-pruinosis, sub lente brevissime hirtellis; foliis oblongo-ellipticis, summo abrupte attenuatis, acutis, utrinque glabris, submembranaceis, subtus brunnescentibus; nervis paucis, paullo prominentibus, reticulatis, petiolo tenui, subbrevi; floribus minimis, axillaribus, paucis, fasciculatis, breviter pedicellatis.—Barra do Rio Negro, Brasilia Septentr. (Spruce, anno 1850–1851).

A tree 15–20 feet in height; the internodes of the branchlets are 1–1½ inch apart; the leaves are 3½–4 inches long, 1¼–1½ in. broad, on a petiole 3 lines in length: about 3–6 flowers in each axillary fascicle; pedicels equal to the length of the flower, only ½ line; disk equal in size to the calyx, both cupuliform; petals 6.

4. *Cathedra crassifolia*, Benth. MSS.;—ramulis glabris, cortice rimoso; foliis oblongo-ellipticis, utrinque acutis, apice anguste attenuatis, subcoriaceis, utrinque opacis et rugulosis, nervis paucis superne immersis, subtus vix prominulis, margine reflexo; floribus paucis, axillaribus, fasciculatis, e nodo promi-

* 'Contributions to Botany,' plate 2.

nente ortis.—Fluv. Guainia et Casiquiare, Brasil. Septentr. (Spruce, 3514).

Its leaves are 3½ inches long, 1¼ in. broad, on a petiole 4 lines in length. The flowers are 1½ line long, on a pedicel of 1 line.

Liriosma.

I have enumerated four species belonging to this genus of the *Olacaceæ*, to which five others are now added.

1. *Liriosma candida*, Pöp. Nov. Gen. iii. 33. tab. 239.

2. *Liriosma pauciflora*, A. DC. Prodr. viii. 673; Deless. Icon. v. tab. 41; huj. op. 2 ser. viii. 106, cum synon.—Bahia (Blanchet);—foliis obovatis, imo obtusis, gradatim acutis, glaberrimis, crassiusculis, utrinque pallide viridibus, supra subnitidis, nervis hinc prominentibus, subtus omnino immersis, margine vix reflexo: 2¼ poll. longis, 1¼ poll. latis.—Bahia (Moricand, 2593).

3. *Liriosma Gardneriana*, A. DC. loc. cit.; huj. op. 2 ser. viii. 108, cum synon.; Contrib. Bot. i. 19. pl. 3.—Prov. Ceará Brasiliæ (Gardner, 1537).

4. *Liriosma Velloziana*, A. DC. loc. cit.; huj. op. l. c. 107, cum synon.; Contrib. Bot. i. 20. pl. 3.—*Dulaccia singularis*, Vell. Flor. Flum. p. 32, et vol. i. tab. 78.—Rio de Janeiro.

5. *Liriosma pallida*, n. sp.;—foliis oblongis, gradatim angustioribus et longe acuminatis, membranaceis, utrinque pallidis, glaberrimis, reticulatis, petiolo brevi; racemo axillari, brevi, sub-6-floro; pedicello calyce corollaque puberulis.—Prope Panurè, Rio Uaupès, Brasil. Septent. (Spruce, 2572).

Its branches and branchlets are slender; the pale leaves, of very thin texture, are 2 inches long and 8 lines broad, on a narrow petiole that does not exceed a line in length: the racemes are 5 or 6 lines long, the pedicels are 1 line long, and the flower in bud 2 lines in length; they are somewhat secund.

6. *Liriosma inopiflora*, n. sp.;—foliis ellipticis vel ovatis, imo subacutis, apice obtusatim attenuatis, et mucronulatis, subcoriaceis, utrinque glaberrimis, supra nitidis, in nervis sulcatis, subtus pallidioribus, glauco-lividis, concavis, nervis paucis brevibus sese arcuatis, margine cartilagineo reflexo, petiolo brevi, glabro, transverse rugoso; racemulis brevissimis, axillaribus, floribus 2–3, rarius pluribus, subsecundis, rachi pedicellisque puberulis, calyce et corolla glabris; drupa ovali, apice umbilicata.—Prope San Carlos, Rio Negro, Amazonas (Spruce, 3487).

A species allied to *L. pauciflora*, but with much shorter

racemes and smaller flowers; its leaves are much darker, thicker, more opaque beneath, more acute at base, all (even younger ones) quite glabrous, excepting along the midrib above; nervures shorter, more spreading; calyx and corolla smooth; branchlets virgate, of a golden-yellow colour and puberulous: its leaves are 3½ inches long, 1¼ inch wide, the petiole being 1½ line in length; the racemes are 4 lines long, the pedicels 1 line, the flowers before opening 2 lines long; the drupe is 8 lines long and 5 lines in diameter.

7. *Liriosma ovata*, n. sp.;—foliis late ovatis, imo obtusis, prope summum attenuatis, hinc obtusis et emarginatis, crassiusculis, supra lucidis, subtus opacis, fuscis, utrinque glabris, nervis paucis sese arcuatis breviter divergentibus omnino immersis, subtus vix visibilibus, margine tenui reflexo, costa mediana superne pubere, subtus glabra, sulcata, petiolo brevi ruguloso; racemulis brevibus axillaribus glabris, 4–6-floris, floribus minoribus, glabris.—Barra do Rio Negro, Amazonas. (Spruce, in flore, sine numero, coll. 1850–51; in fructu immaturo, No. 1366).

In this species the leaves are 2¼–2¾ inches long, 1⅜–1⅝ inch broad, on a petiole 2 lines in length; the racemes are 3 lines long.

8. *Liriosma acuta*, n. sp.;—ramulis virgatis, strictis, glabris, striatis; foliis distantibus, oblongis, imo valde obtusis, infra medium versus summum gradatim acutis, acuminatis, concoloribus, subpallidis, utrinque opacis, supra glabris, subconvexis, nervis immersis, subtus sub lente sparse puberibus, nervis prominulis, reticulatis, margine tenui revoluto, junioribus minoribus et utrinque viridibus, petiolo brevi; racemulis axillaribus, brevibus, paucifloris. — Rio Negro, Amazonas (Spruce, 1508).

The branchlets are long and virgate, the internodes about 1 inch apart; the leaves 3–4 inches long, 1⅜–1⅝ inch broad, on a petiole 2 lines long: the floral racemes, in my specimen, are in a very young state; they are only 3 lines long, both in flower and fruit. The drupe, supported on a very short pedicel, is 11 lines long and 7 lines in diameter; the sarcocarp, in a dried state, is very thin; the putamen is also very thin, marked externally and internally by nine longitudinal lines; the integuments are membranaceous; the albumen is very thick and fleshy, marked by three longitudinal grooves, which terminate at the base in three short hollow spaces, uniting in a long hollow cylindrical cavity in the axis which extends to ¾ of the length of the albumen; in the solid apex, over this space, the minute

embryo is imbedded; the radicle is superior, short, thick, and clavate; the cotyledons are of equal length, but much thinner and narrower.

9. *Liriosma macrophylla*, Bth. MSS.—Olax macrophylla, *Bth. Trans. Linn. Soc.* xviii. 678;—ramulis glabris, striatis; foliis lanceolato-oblongis, utrinque acutis, summo gradatim acuminatis, acutissimis, textura tenui, ubique glaberrimis, superne sublucidis, subtus pallidioribus, opacis, nervis paucis sese arcuatis breviter divergentibus, paullo prominentibus, reticulatis, rachi subtus prominulo et sulcato, margine valde reflexo, petiolo brevissimo, crassiusculo, transverse ruguloso; racemis axillaribus, 6–10-floris.—Rio Casiquiare, in Brasilia Septentrionali (Spruce, 3312).

The leaves are 5½–5¾ inches long, 2½–2¾ inches broad, on a petiole of 2 lines; the raceme is 3–4 lines long; the drupe is 9 lines long, 5 lines in diameter, supported on a pedicel 2 lines in length.

To some of the genera of the *Icacinaceæ* formerly described I have to make the following additions:—

Leretia.

1. *Leretia Vellozii*, nob., huj. op. 2 ser. ix. 392; Contrib. Bot. i. 62. pl. 7.—L. cordata, *Vell. Flor. Flum.* iii. tab. 2.—Rio de Janeiro.

2. *Leretia ampla*, n. sp.;—ramulis angulatis, glaberrimis, cortice laxo, rugoso; foliis majusculis (floralibus minoribus), oblongis, imo obtusis, e medio gradatim acutis, mucronatis, submembranaceis, utrinque glaberrimis, subnitidis, pallescentibus et concoloribus, nervis conspicuis obliquis sese arcuatis subtus prominentibus, valde reticulatis, venis transversalibus, margine integro, petiolo rubro, tereti, striato; paniculis laxis, folio brevioribus, infra axillas oppositifoliis, vel terminalibus, valde ramosis, multifloris, vix pubescentibus; floribus minoribus, petalis extus adpresse pilosis, intus breviter cottoneo- et incano-tomentosis.—Prope San Carlos, Rio Negro, Amazonas (Spruce, 3776).

Its leaves are 8½ inches long, 3¾ inches broad, on a petiole ½ inch in length; the floriferous leaves are only half this size, or still smaller. The very branching inflorescence is 2½ inches broad, as well as long; the flowers in bud are somewhat globose, 1 line in diameter, on short pubescent pedicels.

3. *Leretia nitida*, n. sp.;—ramulis angulatis, glabris, lenticellis

notatis; foliis ellipticis, utrinque acutis, summo attenuatis et hinc interdum obtusis, crassiusculis, ubique glaberrimis, supra intense viridibus, nitidis, infra pallidioribus, nervis obliquis sese arcuatis, infra prominulis, valde reticulatis, margine reflexo, petiolo subbrevi, canaliculato; paniculis axillaribus et terminalibus folio dimidio brevioribus, fulvo-pruinosis, petalis extus pruinosis, intus pilis longis ferrugineo-sericeis donatis. Rio Negro, Amazonas (Spruce, 1528).

Its leaves are 5 inches long, 1¾ inch broad, on a petiole 3 lines in length. The inflorescence is 2 inches long, spreading to a breadth of 1½ inch; the flowers in bud are 1½ line long, on pedicels of ½ a line in length.

Poraqueiba.

When the structure of this genus was described (*huj. op.* 2 ser. ix. 482), I had not been able to detect any apparent dehiscence of the anther-cells: those in the species of which the diagnosis is given below, were, however, sufficiently ripened to show their mode of opening. I find that in each of the four distant cells a rupture takes place, by one of its margins, along the line of its junction with the connective, as has been correctly described by M. Tulasne, and nearly in the manner I have shown to occur in *Emmotum* (*loc. cit.* x. 177). This genus must therefore be referred to the tribe *Emmoteæ* (*loc. cit.* ix. 223). To the generic diagnosis of *Poraqueiba*, as above cited, we must add, to the description of the anthers—

loculis singulatim margine unico a connectivo soluto, hinc rima longitudinali lateraliter dehiscentibus.

1. *Poraqueiba Guianensis*, Aubl., huj. op. 2 ser. ix. 483; Contrib. Bot. i. 71.—Guiana Gallica.
2. *Poraqueiba Surinamensis*, nob., ibid. p. 483; Contrib. Bot. i. 72. tab. 10.—Surinam.
3. *Poraqueiba sericea*, Tulasne, ibid. p. 484; Contrib. Bot. i. 72.—Ega, Amazonas.
4. *Poraqueiba acuminata*, n. sp.;—ramulis cylindricis, tomentillis; foliis ovatis, basi rotundatis vel truncatis, apice subito acuminatis, crassis, coriaceis, superne nitidiusculis, subtus flavido-pruinosis, nervis supra omnino immersis, subtus prominentibus, parallele obliquis, ad marginem vix revolutum arcuatim nexis, venis transversis reticulatis, rachi supra sulcato, subtus valde prominente, petiolo longo crasso canaliculato; racemis axillaribus folio tertio brevioribus, rachi crasso, ramis crassiusculis distantibus, brevibus, divergentibus, floribus fere

sessilibus, hinc agglomerato-spicatis.—Barra do Rio Negro, Amazonas (Spruce, 1748).

This species is distinguished by its thicker and more coriaceous leaves, with their underside and nervures thickly covered by a densely pruinose covering; the nervures above (about eight on each side) are wholly immersed and smooth above, extremely prominent and thick beneath; the main peduncle of the inflorescence is much thicker, and the flowers are perfectly sessile. The leaves are 8–10 inches long, 4½–5¾ inches broad, the petiole being 1 inch long and ⅛ inch thick: the raceme is 2¾ inches long; its thick branchlets are 6–10 lines long, diverging at nearly a right angle: the flowers, at the period of bursting, are 1½ line long.

Emmotum.

To this genus I am enabled to add only partial details of its carpological structure, derived from an examination of Spruce's specimen (No. 1989) of *Emmotum acuminatum*, with which I received a single fruit. This is a drupe of a depressed globular form, 8 lines in diameter, its vertical axis being 5 lines long; its coriaceous sarcocarp, about ⅛ inch thick, covers a rugose osseous indehiscent nut of about the same thickness; the latter is 5-celled, three or four of these cells being much smaller, and evidently semi-abortive; the other cell contained no seed, nothing remaining within but the dried and shrivelled integuments.

1. *Emmotum orbiculatum*, nob., huj. op. 2 ser. x. 178; Contrib. Bot. i. 108.—Pogopetalum orbiculatum, *Benth. Linn. Trans.* xviii. 685. tab. 42.—In Brasilia Septentrionali.

2. *Emmotum acuminatum*, nob., loc. cit. 178; Contrib. Bot. i. 108. tab. 21 B.—Pogopetalum acuminatum, *Benth. loc. cit.* 685.—Rio Negro Brasiliæ.

3. *Emmotum fagifolium*, Desv. in Ham. Prodr. 29; nob., loc. cit. p. 179; Contrib. Bot. i. 189. tab. 21 A.—Pogopetalum acutum, *Benth. in Hook. Lond. Journ. Bot.* ii. 377.—Guiana Gallica.

4. *Emmotum affine*, nob., loc. cit. 180; Contrib. Bot. i. 110.—Pogopetalum affine, *Planch.*—Brasilia (Sellow).

5. *Emmotum nitens*, nob., loc. cit. 180; Contrib. Bot. i. 110. tab. 22 A.—Pogopetalum nitens, *Benth. loc. cit.* ii. 377.—Brasilia intertropica.

6. *Emmotum glabrum*, Bth. MSS.;—foliis ellipticis, utrinque acutis, apice longe attenuatis, glaberrimis, subcoriaceis, supra fusco-viridibus, subtus pallide ferrugineis, margine revoluto,

nervis omnino immersis, lineis striatis transversis interruptis creberrime parallelis utrinque insculptis, costa media rubella, margine revoluto, petiolo canaliculato; paniculis brevibus, petiolo 2–3-plo longioribus, pedunculo pedicellisque pubescentibus, corolla et calyce glabris, hoc dentibus ciliatis, petalis lanceolatis, carina interna dense lanatis.—Rio Guainia et Rio Casiquiare in Brasilia Septentrionali (Spruce, 3536).

The leaves are 3¾ inches long, 1½ inch broad, on a petiole 8 lines in length; the racemes are 6–9 lines long, the flowers in bud 1½ line long; the petals are clothed internally with dense silky long hairs, springing from the prominent keel; the stamens are somewhat shorter than the petals; the filaments are compressed and glabrous; the two cells of the anthers are separated, and fixed upon the margins of an obcordate connective; the ovary is densely clothed with adpressed white sericeous hairs, surmounted by a glabrous style of equal length*.

XXXVIII.—*Notes on the Hydroid Zoophytes.* By Prof. ALLMAN†.

I. *Laomedea tenuis*, n. sp.

A SMALL species of *Laomedea* was found in August last, attached to the fronds of *Laminaria digitata*, dredged from about three fathoms water, off the town of Stromness. It was associated with *L. geniculata*, and, though tolerably abundant, might, from its great delicacy, have been easily overlooked.

I believe it to be an undescribed species, which may be distinguished by the following diagnosis:—

Stem geniculate; polypiferous ramuli having the same diameter as the stem, springing alternately from the geniculations; the entire stem and ramuli distinctly annulated; polype-cells with deeply-cleft margins; polypes very extensile, with 16 or 18 tentacula. Capsules medusiferous, large, cylindrical, with the proximal end conical, and with the remote end broad and truncated.

The present species is nearly allied to *L. lacerata*, which it resembles in its deeply-cleft polype-cells and in the form of its polypes, but must be distinguished from it by its polypiferous ramuli equalling the main stem in thickness, by the form of its capsules, and by their contents, which are here Medusæ, while in *L. lacerata* they are sporosacs.

* A drawing of this species, with analytical details, will be given in 'Contributions to Botany,' plate 22 B.

† The species described in the present notes formed the subject of a paper read by the author at the late Meeting of the British Association at Aberdeen.

In the specimens examined, each capsule contained but a single Medusa, which sprang from the side of a blastostyle, and occupied the greater part of the capsule.

There can, I think, be no doubt that some minute Medusæ which I found free in the phial containing my specimens of *L. tenuis*, and which, so far as comparison was practicable, closely corresponded with those which lay contracted in the interior of the capsules, had been liberated from the present zoophyte. They were provided with a deep umbrella, having its transverse and vertical diameter each equal to about $\frac{1}{80}$ of an inch. The form of the umbrella is rendered peculiar by the abrupt narrowing of its summit. The roof of the bell descends as a conical projection into the axis, and from the truncated apex of this inverted cone there hangs a conical manubrium, whose mouth is furnished with four tentacles, each terminating in a spherical cluster of thread-cells.

Four gastrovascular canals take their origin in the base of the manubrium, and, after ascending along the sides of the conical projection from the roof, descend in the walls of the umbrella to open into the circular canal. At the point where each radiating canal enters the circular canal there is a bulbous dilatation, from which two marginal tentacles are given off; and in the middle point between each of these bulbs there is a similar, though smaller, bulbous dilatation of the circular canal, which gives origin to a single tentacle. The tentacles have their endoderm presenting the usual vacuolated condition; and the thread-cells of their ectoderm are uniformly distributed over their surface, showing no tendency to an arrangement into distinct groups. The velum is moderately wide. There are no lithocysts or ocelli.

In the further development of the Medusa, the marginal tentacles are probably multiplied in each group; at least, in one specimen I found three tentacles springing from a single bulb. The Medusa also appears to belong to a type in which the generative elements are developed in the walls of the manubrium, thus affording an exception to the usual condition of the Medusæ in the *Campanulariadæ*, where the generative elements are formed in special bodies which bud from the radiating canals*.

* In *Sarsia* and its allies the generative elements are formed, as is well known, in the walls of the manubrium, where they lie between the endoderm and ectoderm, a position quite similar to that assumed by them in the sporosac of *Clava*, *Hydractinia*, certain species of *Coryne*, of *Laomedea*, *Sertularia*, &c., as well as in the Medusa-buds of *Eudendrium ramosum*, Van Beneden, and certain other species of *Coryne*.

In *Laomedea dichotoma*, *L. geniculata*, &c., the generative elements are never formed in the manubrium of the Medusa bud, but in peculiar bodies seated on the course of the radiating canals. Now these bodies, at least in

II. *Clava discreta*, nov. sp.

In August last I obtained, upon the under surface of a stone near low-water mark, upon the shore of one of the small rocky islands of Orkney, a species of *Clava* which may be defined by the following short diagnosis:—

Char.—Polypes not grouped into clusters, but distributed at intervals upon a branched creeping stolon.

Clava discreta differs from *C. multicornis* chiefly in the peculiar development of the stolon, which consists of a branched creeping tube, invested with a distinct polypary, and sending up, at intervals of from about $\frac{1}{8}$ to $\frac{1}{2}$ an inch, very short free simple stems whose height scarcely exceeds the diameter of the stolon, and from whose summit the polypes emerge. The polypes are thus widely separated from one another, instead of being collected into clusters as in *C. multicornis*. They are of a light brown colour, and are also smaller than those of *C. multicornis*, scarcely exceeding $\frac{1}{4}$ inch in height. In other respects they closely resemble them. The tentacula are about twelve in number, and the sporosacs are grouped in two or three clusters just behind the proximal tentacula.

The only specimen of this species I obtained was attached to the dead stolon of some other zoophyte, probably a *Coryne*, which it accompanied in its ramifications over the under surface of the stone on which it grew.

III. *Dicoryne stricta*, nov. gen. and sp.

The subject of the present note was dredged at Orkney in August last, in water of about three fathoms depth. It invested an old *Buccinum undatum* which contained a Hermit Crab, and

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the Medusa of *Laomedea dichotoma*, which I carefully examined with regard to this point, are constructed precisely on the plan of the sporosacs in *Clava*, *Hydractinia*, &c. These sporosacs must be viewed as special zooids representing one term in the "alternation of generations" of the individual. Just so must the reproductive bodies (sporosacs) which bud from the radiating canals of the Medusa of *Laomedea dichotoma* be regarded as special zooids, and as representing a term in the life-series of the zoophyte.

In *Eudendrium ramosum*, for example, we have therefore this series represented by two terms:—

[Ovum] polype, medusa;

while in *Laomedea dichotoma* it is represented by three:—

[Ovum] polype, medusa, sporosac.

In the *Eudendrium*, the series stops with the production of a *sexual* zooid in the form of a Medusa; in the *Laomedea* it goes on through the *non-sexual* Medusa-bud until it finds its termination in the sexual sporosac-bud of the latter.

which was partly covered with *Hydractinia echinata*. Its generic and specific characters are embraced in the following diagnosis:—

DICORYNE.

Char.—Cœnosarc branched, clothed with a polypary and adhering by a tubular network. Polypes claviform, of two kinds, one sterile, the other proliferous, both borne upon the common cœnosarc, and issuing from the extremities of the branches. Sterile polypes with a verticil of filiform tentacula situated behind the mouth; proliferous polypes destitute of tentacula (and mouth ?), and having the gonophores clustered round their base.

D. stricta. Stem rising to the height of about ½ an inch, irregularly branched; branches ascending at a very acute angle from the stem. Polypary slightly dilated at the extremities of the branches, somewhat corrugated near the base, but without distinct annulations. Tentacula about 16, in a slightly alternating verticil.

The only specimen of *Dicoryne stricta* I obtained was male. The polypary possessed but little transparency, and, as well as the polypes, was of a light brown colour. From the basal tubular network, besides the branched colonies, there also sprang unbranched stems which ascended vertically to the length of about a line, and bore each a terminal polype. These are apparently young zooids not yet complicated by branching, though many of the polypes seemed to have attained maturity, and presented the same difference of form as in the branched colony,—being in some cases tentaculiferous and sterile polypes; in others, polypes destitute of tentacles, and loaded with gonophores.

The habitat of *D stricta* seems to be entirely similar to that of *Hydractinia echinata**.

XXXIX.—*Characters of some apparently undescribed Ceylon Insects.* By F. WALKER.

[Continued from vol. iii. p. 265.]

Order HYMENOPTERA.

Fam. Formicidæ.

FORMICA EXERCITA. *Fœm.* Nigra, densissime et scitissime punctata, antennis subfiliformibus, scapo flagelloque apice rufescentibus,

* In Professor Huxley's beautiful and philosophic memoir on the Oceanic Hydrozoa, just published by the Ray Society, he has proposed a terminology, partly special for the particular groups which form the subject of his memoir, and partly intended to apply to the Hydrozoa in general. I would gladly have adopted several of Professor Huxley's terms in the present paper, if I could have done so without accompanying them with definitions which would have inconveniently increased the length of these notes.

clypeo subcarinato incisuris duabus anticis, coxis femoribusque rufis, his apice nigris, alis fuscis, venis nigricantibus, stigmate nigro. *Mas.* Gracilis, antennis apice rufis, pedibus piceis.

Female. Black, very thickly and finely punctured. Antennæ subfiliform; tips of the scape and of the flagellum reddish. Clypeus slightly keeled, with a notch on each side in front. Legs moderately stout; coxæ and femora red, the latter with black tips. Wings brown; veins blackish, in structure much like those of *Polyrhachis militaris*; stigma black. Length of the body 4 lines; of the wings 8 lines. *Male.* More slender. Antennæ slender, red towards the tips. Legs slender, piceous. Length of the body 3½ lines; of the wings 7 lines.

Formica exundans. *Mas.* Nigra, elongata, scitissime punctata, antennis piceis filiformibus corpore vix brevioribus, abdomine longi-fusiformi, segmentorum marginibus pedibusque pallide piceis, alis cinereis, venis nigricantibus, stigmate nigro.

Male. Black, elongate, very finely punctured. Antennæ piceous, filiform, nearly as long as the body. Abdomen elongate fusiform; hind borders of the segments and legs pale piceous; scale of the peduncle large. Wings cinereous; veins much like those of the preceding species; stigma black. Length of the body 4 lines of the wings 6 lines.

Formica meritans. *Mas.* Nigra, elongata, nitens, pubescens capite impresso, ore fulvo, antennis piceis filiformibus corpore paullo brevioribus, metathorace elongato transverse impresso, segmentorum abdominalium marginibus posticis rufis, pedibus piceis longiusculis, alis nigro-fuscis, venis stigmateque nigris.

Male. Black, elongate, shining, pubescent. Head with an impression between the ocelli and the base of the antennæ. Mouth tawny. Antennæ piceous, filiform, a little shorter than the body. Metathorax elongate, slightly impressed across the middle. Peduncle of the abdomen conical. Hind borders of the abdominal segments red. Legs piceous, rather long. Wings blackish brown; veins and stigma black, the former like those of *F. exercita* in structure. Length of the body 5 lines, of the wings 6 lines.

Formica latebrosa. *Mas.* Testacea, antennis gracillimis, scapo longissimo, metathorace lævi, abdomine nigro, petiolo testaceo, pedibus longis debilibus, alis albis, venis stigmateque testaceis.

Male. Testaceous. Antennæ very slender; scape very long, slightly increasing in thickness from the base to the tip, much more than half the length of the flagellum. Metathorax smooth. Abdomen black; peduncle and its node testaceous. Legs long, slender. Wings white; veins and stigma testaceous, the former in structure like those of *F. exercita.* Length of the body 4 lines; of the wings 7 lines.

Formica pangens. *Mas.* Testacea, scitissime punctata, capite supra piceo, antennis filiformibus corpore valde brevioribus, scapo

brevissimo, abdomine elliptico, antice piceo, pedibus breviusculis, alis cinereis, venis testaceis, stigmate nigro.

Male. Testaceous, slightly shining, very finely and minutely punctured. Head piceous above. Antennæ filiform, much shorter than the body; scape very short. Abdomen elliptical, very little longer than the thorax; fore-half piceous. Legs rather short. Wings cinereous; veins testaceous, in structure like those of *Tapinoma erratica*; stigma black. Length of the body 2¼ lines; of the wings 4 lines.

FORMICA INGRUENS. *Fœm*. Nigra, scitissime punctata, capite magno, mandibulis tarsisque testaceis, antennis corporis dimidio non longioribus, scapo longo subclavato, flagello rufescente subclavato, abdomine lato brevi-elliptico, pedibus robustis breviusculis, alis cinereis parvis, venis piceis, stigmate nigro.

Female. Black, shining, very finely punctured. Head large; mandibles testaceous. Antennæ about half the length of the body; scape subclavate, much more than half the length of the flagellum; the latter reddish, subclavate. Abdomen short-elliptical, very much broader than the thorax. Legs short, stout; tarsi testaceous. Wings cinereous, narrow, short; veins piceous, in structure like those of *F. pangens*; stigma black. Length of the body 2¼ lines, of the wings 4 lines.

FORMICA DETORQUENS. *Fœm*. Nigra, scitissime punctata, capite parvo, antennis subfiliformibus corporis dimidio paullo longioribus, scapo longo, abdomine elliptico, pedibus breviusculis, tarsis testaceis, alis pallide cinereis, venis stigmateque testaceis.

Female. Black, shining, very finely punctured. Head small, a little more than half the length of the body. Antennæ nearly filiform; scape much more than half the length of the flagellum. Abdomen elliptical, hardly longer or broader than the thorax. Legs short; tarsi testaceous. Wings pale cinereous; veins and stigma testaceous; the former in structure much like those of *Tapinoma erratica*, but the discal areolet is open on the exterior side. Length of the body 1¾ line; of the wings 3 lines.

FORMICA DIFFIDENS. *Fœm*. Fulva, gracilis, aptera, capite nigro elongato, mandibulis magnis fulvis, antennis fulvis subfiliformibus, metathorace petioloque longis, abdomine nigro elliptico, pedibus posticis piceis, tarsis posticis testaceis.

Female. Tawny, slender, apterous. Head black, elongate. Mandibles large, tawny. Antennæ tawny, nearly filiform; scape moderately long. Metathorax and peduncle long. Abdomen black, elliptical, shorter than the thorax. Hind legs piceous; hind tarsi testaceous, long, slender. Length of the body 2 lines.

The description is taken from an injured specimen.

FORMICA OBSCURANS. *Fœm*. Nigra, sat gracilis, scitissime punctata, capite longi-quadrato, mandibulis magnis fulvis, antennis corporis dimidio vix brevioribus, scapo longo subclavato, flagello fulvo sub-

clavato, mesothorace sublineato, abdomine latiusculo, pedibus piceis, alis albidis, venis stigmateque testaceis.

Female. Black, rather slender, slightly shining, very finely punctured. Head elongate-quadrate; mandibles large, tawny. Antennæ nearly half the length of the body; scape subclavate, about two-thirds of the length of the flagellum; the latter tawny, subclavate. Prothorax and metathorax well developed; mesothorax with a slight middle line. Abdomen broader than the thorax. Legs piceous. Wings whitish; veins and stigma testaceous; the former in structure like those of *Tapinoma erratica.* Length of the body 4 lines; of the wings 6 lines.

FORMICA INDEFLEXA. *Fœm.* Picea, gracilis, aptera, scitissime punctata, capite sat magno, mandibulis parvis, antennis subfiliformibus corporis dimidio non longioribus, flagello basi scapoque testaceis, thorace subcompresso, pedibus fulvis, tibiis nigris basi fulvis, tarsis testaceis.

Female. Piceous, slender, apterous, very finely punctured. Head rather large; mandibles small. Antennæ slender, not more than half the length of the body, nearly filiform; scape tawny, much shorter than the flagellum, the latter tawny towards the base. Thorax somewhat compressed; metathorax, peduncle and its node well developed. Abdomen mutilated. Legs tawny; tibiæ black, tawny at the base; tarsi testaceous. Length of the body 4 lines.

FORMICA CONSULTANS. *Mas.* Nigra, elongata, scitissime punctata, capite parvo antice fulvo, mandibulis minimis, antennis piceis filiformibus corpore valde brevioribus, scapo brevissimo, abdomine rufescente elliptico fascia media nigra, pedibus testaceis, alis cinereis, latiusculis, venis testaceis, stigmate piceo.

Male. Black, elongate, slightly shining, very finely punctured. Head rather small, tawny in front; mandibles very small. Antennæ piceous, slender, filiform, much shorter than the body; scape very short. Abdomen reddish, elliptical, a little broader than the thorax, with a black middle band. Legs testaceous, slender. Wings cinereous, rather broad; veins testaceous, in structure much like those of *Formica exercita*; stigma piceous. Length of the body 3 lines; of the wings 5 lines.

POLYRHACHIS ILLAUDATUS. *Mas.* Niger, subaurato-tomentosus, clypeo subsulcato lateribus elevatis, antennis filiformibus corpore paullo brevioribus, scuto bispinoso, scutello emarginato, metathorace lateribus elevatis incisis postice bispinoso, abdomine lato brevissime elliptico, pedibus robustis.

Male. Black, apterous, with slightly gilded tomentum. Clypeus with a very slight middle furrow, and with a ridge along each side. Antennæ filiform, a little shorter than the body; scape very long, but shorter than the flagellum. Scutum with two long sharp spines, which are directed obliquely forward; scutellum shield-shaped, truncated at the tip, emarginate on each side. Metathorax with a notched ridge on each side. Peduncle

thick, widening hindward; two posterior spines, which are directed hindward. Abdomen very short, elliptical, much broader than the thorax. Legs robust. Length of the body 4¼ lines.

MYRMICA CONSTERNENS. *Mas.* Testacea, gracilis, nitens, capite parvo supra nigro, antennis filiformibus thorace non longioribus, abdomine subfusiformi, pedibus parvis, alis albidis, venis stigmateque testaceis. *Neut.*? Nigra, capite magno elongato, antennis testaceis subclavatis, thorace testaceo compresso, abdomine brevi-ovato, pedibus testaceis.

Male. Testaceous, slender, shining. Head small, vertex black. Antennæ filiform, paler than the body, not longer than the thorax. Peduncle with two small nodes. Abdomen nearly fusiform, a little longer than the thorax. Legs short, slender. Wings whitish; veins and stigma testaceous, the former in structure much like those of *Polyrhachis militaris.* Length of the body 2½ lines; of the wings 5 lines.

Worker? Black. Head large, elongate. Antennæ short, testaceous, subclavate. Thorax testaceous, compressed, narrower than the head, attenuated and partly black hindward. Abdomen short-oval, broader than the head. Legs testaceous; femora mostly piceous. Length of the body ¾ line.

CREMATOGASTER PELLENS. *Fœm.* Fulvus, gracilis, pubescens, capite subrotundo, mandibulis latis trigonis, antennis testaceis clavatis, metathorace bidentato, abdomine longi-elliptico, pedibus testaceis breviusculis, alis albidis amplis, venis stigmateque testaceis.

Female. Tawny, shining, minutely pubescent. Head nearly round; mandibles short, broad, triangular. Antennæ testaceous, clavate, shorter than the thorax. Metathorax with two short stout spines. First node of the peduncle much longer than the second. Abdomen long-elliptical, very convex beneath, longer and broader than the thorax. Legs short, testaceous; femora sometimes darker. Wings whitish, ample; veins and stigma testaceous, the former in structure like those of *Crematogaster castaneus.* Length of the body 4 lines; of the wings 8 lines.

CREMATOGASTER DEPONENS. *Fœm.* Niger, nitens, punctatus, capite elongato subsulcato, mandibulis piceis latis trigonis, antennis breviusculis rufescentibus subclavatis, thorace fusiformi subcompresso, metathorace bidenticulato, petioli nodis conicis, abdomine rufo fusiformi, pedibus rufis breviusculis, alis fuscescentibus, venis stigmateque nigris.

Female. Black, shining, punctured. Head elongate, with a slight longitudinal furrow; mandibles piceous, short, broad, triangular, with minute teeth. Antennæ short, reddish, subclavate. Thorax fusiform, slightly compressed; metathorax with two minute teeth. Peduncle with two conical nodes. Abdomen red, fusiform, longer and broader than the thorax. Legs red, short. Wings brownish; veins and stigma black, the former very strongly marked, extending to the border, in structure somewhat like those

of *Formica rufa* and of *Crematogaster castaneus*, but differing slightly from both. Length of the body 3¼ lines; of the wings 6 lines.

CREMATOGASTER FORTICULUS. *Neut.* Niger, sat angustus, scitissime punctatus, capite subquadrato, mandibulis parvis piceis, antennis subclavatis thorace non longioribus, abdomine longi-elliptico latiusculo, pedibus breviusculis, tarsis pallide testaceis.

Worker. Black, rather narrow, slightly shining, very finely punctured. Head subquadrate, a little broader than the thorax; mandibles small, piceous. Antennæ subclavate, as long as the thorax. Abdomen long-elliptical, longer and broader than the thorax. Legs rather short; tarsi pale testaceous. Length of the body 1¾ line.

PSEUDOMYRMA? ALLABORANS. *Mas.* Nigra, gracilis, brevis, nitens, capite antice fulvo, antennis subclavatis pallide luteis, petioli nodis magnis globosis, abdomine fusiformi suturis pallidis, pedibus fulvis breviusculis robustis, alis albidis, venis stigmateque nigris. *Fœm.* Antennis clavatis, femoribus posticis nigris. *Neut.* Capite lato, thoracis segmentis bene determinatis; abdomine longi-elliptico.

Male. Black, slender, smooth, shining. Head tawny in front. Antennæ pale luteous, subclavate. Peduncle with large globose nodes. Abdomen fusiform, longer than the thorax; sutures pale. Legs tawny, short, stout. Wings whitish; veins and stigma black. Length of the body 2 lines; of the wings 3 lines. *Female.* Antennæ clavate. Hind femora black. Length of the body 3½ lines. *Worker.* Head broader than the thorax. Segments of the thorax much developed. Abdomen long-elliptical, not longer than the thorax. Length of the body 3 lines.

ATTA DIDITA. *Neut.* Picea, pubescens, scitissime scabrosa, capite maximo quadrato scite striato bituberculato, scuto gibbosulo, scutello minimo, metathorace valde declivi, petioli nodo 2° globoso lato, abdomine brevi-elliptico, pedibus fulvis.

Worker major. Piceous, pubescent, very finely scabrous. Head quadrate, very large, twice the breadth of the thorax, finely striated longitudinally, with two protuberances above. Antennæ reddish, subclavate. Scutum somewhat gibbous; scutellum very small. Metathorax very slanting. First node of the peduncle rather narrow, minutely quadridentate; second globose, much broader. Abdomen short-elliptical. Legs tawny. Length of the body 3 lines.

Worker minor?. Head much smaller. Thorax less developed. Second node of the peduncle narrower. Abdomen black, round. Legs short, stout. Length of the body 2 lines.

This is probably a distinct species.

MERANOPLUS DIMICANS. *Neut.* Rufescens, convexus, brevis, latus, scabrosus, pilosus, capite subquadrato, antennis clavatis, scutello bi-

spinoso, metathorace bispinuloso, abdomine latiore nigro brevi-elliptico, pedibus breviusculis.

Worker. Reddish, convex, short, broad, scabrous, pilose. Head subquadrate, a little broader than the thorax. Antennæ clavate. Scutellum with two long acute spines, which are directed obliquely hindward. Metathorax with two small spines. Abdomen black, short-elliptical, broader than the thorax. Legs short. Length of the body 2 lines.

Fam. Mutillidæ.

Tiphia decrescens. *Fœm.* Nigra, nitens, scitissime punctata, antennis subtus rufis, prothoracis margine postico rufescente, abdomine fusiformi subtus apice rufescente, pedibus rufis, coxis femoribusque nigris, his apice rufis, alis cinereis, venis stigmateque nigris.

Female. Black, shining, very finely punctured. Head a little broader than the thorax; clypeus somewhat truncated, with a transverse furrow at its base. Antennæ red beneath. Hind border of the prothorax reddish. Metathorax with two striæ, which converge hindward. Abdomen fusiform, reddish beneath at the tip. Legs red, short, thick; coxæ and femora black, the latter with red tips. Wings cinereous; veins and stigma black; third submarginal areolet extending almost as far as the marginal areolet, about half the length of the third discoidal areolet. Length of the body 3 lines; of the wings 5 lines.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

An Illustrated Index of British Shells, with Coloured Figures of all the Species. By G. B. Sowerby, F.L.S. Simpkin and Co. 1859.

We are glad to find collectors of British shells supplied with a useful and beautiful manual of species at a comparatively small price. Hitherto they have been unable to procure any work containing the whole or any large portion of the species, without incurring an expense of many pounds. Mr. Sowerby now gives them the whole six hundred species, well figured, and arranged in such a manner that the reader can turn to a given plate and its opposite page, and learn at a glance what he wishes to know of the localities, habits, and relative characters of all the species of a given genus. The author claims to introduce about fifty new species. Some of these have been figured in other books as mere varieties, others are figured for the first time from specimens described by Mr. Jeffreys and others in the 'Annals.' We are by no means inclined to decide on the specific value of the distinctions asserted; but the author has left us in no doubt as to what they are. We wish success to this well-conceived and well-executed endeavour to supply a public want.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

January 11, 1859.—Dr. Gray, F.R.S., V.P., in the Chair.

On the Gorilla (Troglodytes gorilla, Sav.)*. By Prof. Owen, F.R.S., V.P.Z.S., &c.

Before referring to earlier indications of the truly extraordinary animal of which an entire specimen has now been obtained,—indications scarcely more instructive or convincing to the naturalist than those afloat on the Unicorn or Succatyro,—the author proceeded briefly to recapitulate the steps which led to the determination and full knowledge of the great anthropoid Ape of Africa called *Troglodytes gorilla.*

The first authentic information he had received of its existence was by a letter from Dr. Savage, dated 'Gaboon River, West Africa,' April 24, 1847, inclosing a sketch of the cranium, and requesting that the results of Prof. Owen's comparison might be communicated to him. That letter and those results are given in the 'Proceedings of the Zoological Society' for February 22, 1848; together with the description of three skulls, two of male and one of a female, which had been transmitted from the Gaboon to England, and which established the distinction of the species (*Troglodytes gorilla*) from the Chimpanzee (*Troglodytes niger*)†.

The skulls obtained by Dr. Savage, at the Gaboon, were taken by him to Boston, U. S., and were described by the Doctor and Prof. Wyman, in the 'Journal of the Natural History Society of Boston,' vol. v., 1847, and the name *Troglodytes gorilla* was proposed for the species, the discovery of which is due to Dr. P. S. Savage.

Translations of Dr. Wyman's and Prof. Owen's papers being published in the 'Annales des Sciences Naturelles', the attention of Continental Naturalists was strongly excited toward this unexpected addition to the Mammalian class; and the inducements held out for the collection of specimens speedily led to the acquisition of the requisite materials for completing the zoographical history of the animal which it seems now agreed to call 'Gorilla.' The additional materials which reached London, enabled the author to communicate to the Zoological Society ('Proceedings of the Zool. Soc.' for Nov. 11th, 1851.)‡ a description of the entire skeleton of the *Troglodytes gorilla*; of which, however, owing to the number and cost of the illustrations, two parts only have yet appeared in the 'Transactions of the Society' (vol. iv., pt. iii., p. 75, pls. 26–30 & pt. iv., p. 89, pls. 31–36.): but the main facts are recorded in the author's Catalogue of the 'Osteological Collection in the Museum of the Royal College of Surgeons,' 4to, pp. 782–804. Entire skeletons

* This paper will be printed in the 'Transactions,' illustrated with several plates.

† 'Transactions of the Zool. Soc.' vol. iii., p. 381, pls. 58–63.

‡ See also 'Literary Gazette,' Nov. 15, 1851.

of the full-grown *Troglodytes gorilla* are now set up in the Museum of the College, and in the British Museum; and Dr. Gray has finally acquired for the National Collection the stuffed specimen of a nearly adult male Gorilla.

All the foregoing specimens were obtained from a part of the west coast of tropical Africa traversed by the rivers 'Danger' and 'Gaboon,' in latitudes 1° to 15° S.

A corresponding series of illustrations, first crania, then the skeleton, finally an entire specimen of the *Troglodytes gorilla*, have successively reached the Museum of the Garden of Plants, Paris, and have afforded materials for interesting and instructive memoirs from the accomplished Professors in that noble establishment for extending and diffusing the science of Natural History.

De Blainville had caused a lithograph to be prepared of the skeleton of the Gorilla, shortly before his demise. His successor, Prof. Duvernoy, communicated a description of this skeleton to the Academy of Sciences in 1853, which is published, with some interesting particulars of the anatomy of the soft parts, in the 'Archives du Muséum d'Histoire Naturelle,' tome vii. (1855). The Memoirs and Observations by his accomplished colleague the Professor of Mammalogy and Ornithology, Isidore Geoffroy St. Hilaire, on the Gorilla will be found in the 'Comptes Rendus de l'Académie des Sciences,' January 19, 1852, and subsequent numbers; in the 'Revue de Zoologie,' No. II., 1853; the whole being summed up in the part of his excellent 'Description des Mammifères nouveaux,' &c. 4to, which appeared in vol. x. of the 'Archives du Muséum, 1858.'

The differences in the results of the observations by the American, French, and English authors, relate chiefly to the interpretation of the facts observed. Dr. Wyman agrees with Prof. Owen in referring the Gorilla to the same genus as the Chimpanzee, but he differs from him in regarding the latter as being more nearly allied to the Human kind. Professors I. Geoff. St. Hilaire and Duvernoy regard the differences in the osteology, dentition, and external characters of the Gorilla to be of generic importance, and enter it in the Zoological Catalogue as *Gorilla Gina*, the *nomen triviale* being taken from 'Weggeena;' 'N. Gina' and 'D. jina,' as the name of the beast in the Gaboon tongue, has been diversely written by voyagers*. The French naturalists also concur with the American in placing the Gorilla below the Chimpanzee in the scale. The author returned to the discussion of those questions at the conclusion of his paper, when he also referred to the notion current in some works that the long-armed apes (*Hylobates*), and not the Orangs or Chimpanzees, were the most anthropoid of apes.

Entering upon the description of the exterior characters of the

* The main discrepancy, in regard to matter of fact, is that the arms of the Gorilla are stated by Isid. Geoffroy, to be much longer, whilst Prof. Owen found them to be relatively shorter, than those of the Chimpanzee.

"Bras { de proportions presque humaines .... Genre I. *Troglodytes*.
beaucoup plus longs que chez l'homme ... Genre II. *Gorilla*."

Isid. Geoffr., p. 15

adult male Gorilla, the stuffed skin of which is now in the British Museum, Prof. Owen first called attention to the shortness, almost absence, of the neck, due to the backward articulation of the head to the trunk and the concomitant development of the spines of the neck-vertebræ; also to the chin which, in the usual pose of the head, descends below the *manubrium sterni*; to the great size of the scapulæ, to the elevation of the acromion, and the oblique position of the clavicles which rise from their sternal attachments obliquely to above the level of the angles of the jaw. The brain-case, low and narrow, passes in the old male in an almost straight line from the occiput to the superorbital ridge, the prominence of which gives the most forbidding feature to the physiognomy of the Gorilla. It is a feature strongly marked on the skeleton, but is exaggerated in the stuffed animal by the thick supraciliary roll of integument which forms a scowling penthouse over the small deep-set eyes. The nose is a more prominent feature than in the Chimpanzee or Orang-utan; there is a slight median rise along its upper half, answering to the feeble prominence of the same part of the nose-bones, but the lower or alar part of the nose offers two thick projections, arching, each across its own nostril, and becoming thicker as it subsides in the upper lip. There is a median longitudinal depression between these arched flaps; but their prominence brings them into view in the profile of the face. The point of median confluence of the alæ projects a little beyond the fore part of the 'septum narium.' The resemblance to the lowest form of the negro nose is much closer in the Gorilla than in the Chimpanzee. The mouth is wide, the lips large and thick, but of uniform thickness, the upper one terminating by a straight, almost as if incised, margin; but being relatively shorter than in the Chimpanzee. The dark pigment is continued from the base of the lip to this margin, and no part of the red inner lining would be visible when the lips were naturally closed: a little of this lining, which forms what is commonly understood by 'lip' in man, might be shown by the under lip of the Gorilla, but it is obscured by added pigment, as in most negro races. The chin is short and receding, but the whole face is prominent. The circumference of a front view of the head presents an oval with the great end downward and the upper end very narrow, owing to the parietal ridge, in the old male. The superorbital or cranial part is confined to the upper fourth in this view, and the bestial aspect of the visage is much increased when the huge prominent tusks are exposed by opening the lips. The eyelids have eyelashes almost as in man; but the eyebrow is not defined, the hair of the head extending to the supraciliary roll, which is almost devoid of hair. In a direct front view the ears are rather above the level of the eyes: they are as much smaller in proportion to the head, as in the Chimpanzee they are larger, in comparison with man; but in structure they resemble the human auricle more than does the ear of any other ape.

The tragus and anti-tragus, the helix and anti-helix, the concha, the fossa of the anti-helix and the lobulus are distinctly defined: the

chief difference is the large size of the concha compared with the fossa of the anti-helix and the lobulus: but though the lobulus is small it is distinctly marked and pendulous, while it is sessile in the Chimpanzee and Orang. Both tragus and anti-tragus are nearly as prominent as in man. The helix is reflected or folded centrally from its origin to opposite the anti-tragus as in man, whereas, in the Chimpanzee the fold subsides opposite the fossa of the anti-helix, and the rest of the margin of the auricle is simple, not folded. The upper part of the helix is more produced in the Gorilla than in man, and the greatest breadth of the ear is above the concha, in which the incisura intertragica is less deep than in man.

The skin of the face is naked and much wrinkled; a pretty deep indent divides the nasal ala from the cheek, and becomes shallower as it bends upward, inward, and downward to the median indent between the alæ. The hairy part of the scalp is continued to the superorbital prominence, and thence the hair-clad skin is continued outward and downward upon the sides of the deep cheeks, where the hair is long. The chest is of great proportional capacity, and the shoulders very wide across. The profile of the trunk behind describes a slight convexity from the nape, which projects beyond the occiput, downward to the sacrum: there is no inbending at the loins, which seem wanting. The abdomen is prominent both before and at the sides. The pectoral regions are slightly marked and show the pair of nipples placed as in the Chimpanzee and Man. In the male the penis is short and subconical, the prepuce is devoid of frænum; the scrotum is broader and more sessile than in man: the perinæum is longer, the anus being placed further back than in man. There is no trace of ischial callosities. The glutæi are better developed and give more of the appearance of nates than in any other anthropoid ape, but they do not project so as to meet beyond the anus and conceal it.

The chief deviations from the human structure are seen in the limbs, which are of great power, the upper ones prodigiously strong, making by comparison the legs, through the want of 'calves', look feeble.

The first characteristic is the almost uniform thickness of each segment of the limb: this is seen in the arm, from below the short deltoid prominence to the condyles, neither biceps nor triceps making any definite swelling; a like uniform thickness is seen in the antibrachium from below the olecranon to the wrist: the leg a little increases in thickness from the knee to the ankle: the short thigh shows some decrease as it descends: but there is a general absence of those partial muscular enlargements which impart the graceful varying curves to the outlines of the limbs in man. Yet this, upon dissection, is found to depend rather on excess, than defect, of development of the carneous as compared with the tendinous parts of the limb-muscles, which thus continue of almost the same size from their origin to their insertion, with a proportionate gain of strength to the beast. The difference in the length of the upper limbs between the Gorilla and Man is but little in comparison with the trunk; it appears

greater through the arrest of development of the lower limbs. Very significant of the closer anthropoid affinities of the Gorilla is the superior length of the arm (humerus) to the fore-arm, as compared with the proportions of those parts in the Chimpanzee. The hair of the arm inclines downward, that of the fore-arm upward, as in the Chimpanzee. The thumb extends a little beyond the base of the proximal phalanx of the fore-finger; it does not reach to the end of the metacarpal bone of that finger in the Chimpanzee or any other ape: the thumb of the Siamang (*Hylobates syndactyla*) is still shorter in proportion to the length of the fingers of the same hand: the philosophical zoologist will see great significance in this fact. In man the thumb extends to, or beyond, the middle of the first phalanx of the fore-finger.

The fore-arm in the Gorilla passes into the hand with very slight evidence, by constriction of the wrist, the circumference of which, without the hair, was fourteen inches, that of a strong man averaging eight inches. The hand is remarkable for its breadth and thickness, and for the great length of the palm, occasioned both by the length of the mètacarpus and the greater extent of undivided integument between the digits than in man; these only begin to be free opposite the middle of the proximal or first phalanges in the Gorilla. The digits are thus short, and appear as if swollen and gouty; and are conical in shape after the first joint, by tapering to nails, which, being not larger or longer than those of man; are relatively to the fingers much smaller. The circumference of the middle digit at the first joint in the Gorilla is $5\frac{1}{2}$ inches; in man, at the same part, it averages $2\frac{3}{4}$ inches. The skin covering the middle phalanx is thick and callous on the back of the fingers, and there is little outward appearance of the second joint. The habit of the animal to apply those parts to the ground, in occasional progression, is manifested by these callosities. The back of the hand is hairy as far as the divisions of the fingers; the palm is naked and callous. The thumb, besides its shortness, according to the standard of the human hand, is scarcely half so thick as the fore-finger. The nail of the thumb did not extend to the end of that digit; in the fingers the nail projected a little beyond the end, but with a slightly convex worn margin, resembling the human nails in shape, but relatively less.

In the hind limbs, chiefly noticeable was that first appearance in the quadrumanous series of a muscular development of the gluteus, causing a small buttock to project over each tuber ischii. This structure, with the peculiar expanse, as compared with other *Quadrumana*, of the iliac bones, leads to an inference that the Gorilla must naturally and with more ease resort occasionally to station and progression on the lower limbs than any other ape.

The same cause as in the arm, viz. a continuance of a large proportion of fleshy fibres to the lower end of the muscles, coextensive with the thigh, gives a great circumference to that segment of the limb above the knee-joint, and a more uniform size to it than in man. The relative shortness of the thigh, its bone being only eight-ninths the length of the humerus (in man the humerus averages five-sixths

the length of the femur), adds to the appearance of its superior relative thickness. Absolutely the thigh is not of greater circumference at its middle than is the same part in man.

The chief difference in the leg, after its relative shortness, is the absence of a "calf," due to the non-existence of the partial accumulation of carneous fibres in the upper half of the gastrocnemii muscles, causing that prominence in the type-races of mankind. In the Gorilla the tendo-achillis not only continues to receive the "penniform" fibres to the heel, but the fleshy parts of the muscles of the foot receive accessions of fibres at the lower third of the leg, to which the greater thickness of that part is due, the proportions in this respect being the reverse of those in man. The leg expands at once into the foot, which has a peculiar and characteristic form, owing to the modifications favouring bipedal motion being superinduced upon an essentially prehensile quadrumanous type. The heel makes a more decided backward projection than in the Chimpanzee; the heel-bone is relatively thicker, deeper, more expanded vertically at its hind end, besides being fully as long as in the Chimpanzee. This bone, so characteristic of anthropoid affinities, is shaped and proportioned more like the human calcaneum than in any other ape. The malleoli do not make such well-marked projections as in man; they are marked more by the thickness of the fleshy and tendinous parts of the muscles that pass near them, on their way to be inserted into parts of the foot. Although the foot be articulated to the leg with a slight inversion of the sole, it is more nearly plantigrade than in the Chimpanzee or any other ape. The hairy integument is continued along the dorsum of the foot to the clefts of the toes, and upon the first phalanx of the hallux: the whole sole is bare.

The hallux (great toe, thumb of the foot), though not relatively longer than in the Chimpanzee, is stronger; the bones are thicker in proportion to their length, especially the last phalanx, which in shape and breadth much resembles that in the human foot. The hallux in its natural position diverges from the other toes at an angle of 60 deg. from the axis of the foot; its base is large, swelling into a kind of ball below, upon which the thick callous epiderm of the sole is continued. The transverse indents and wrinkles show the frequency and freedom of the flexile movements of the two joints of the hallux: the nail is small, flat, and short. The sole of the foot gradually expands from the heel forward to the divergence of the hallux, and seems to be here cleft, and almost equally, between the oase of the hallux and the common base of the other four digits. These are small and slender in proportion, and their bases are enveloped in a common tegumentary sheath as far as the base of the second phalanx. A longitudinal indent at the middle of the sole, bifurcating—one channel defining the ball of the hallux, the other running towards the interspace between the second and third digit—indicates the action of opposing the whole thumb (which seems rather like an inner lobe or division of the sole), to the outer division terminated by the four short toes. What is termed the "instep" in man is very high in the Gorilla, owing to the thickness of the carneo-

tendinous parts of the muscles as they pass from the leg to the foot over this region. The mid-toe (third) is a little longer than the second and fourth; the fifth, as in man, is proportionally shorter than the fourth, and is divided from it by a somewhat deeper cleft. The whole sole is wider than in man—relatively to its length much wider,—and in that respect, as well as by the offset of the hallux, and the definition of its basal ball, more like a hand, but a hand of huge dimensions and of portentous power of grasp.

In regard to the outward coloration of the Gorilla, only from the examination of the living animal could the precise shades of colour of the naked parts of the skin be truly described. Much of the epiderm had peeled off the subject of the present description; but fortunately in large patches, and the texture of these had acquired a certain firmness, apparently by the action of the alcohol upon the albuminous basis. The able taxidermist, Mr. Bartlett, has availed himself of this circumstance in the correct and satisfactory preparation of the specimen now mounted for the British Museum. The parts of the epiderm remaining upon the face indicated the skin there to be chiefly of a deep leaden hue; it is everywhere finely wrinkled, and was somewhat less dark at the prominent parts of the supraciliary roll and the prominent margins of the nasal "alæ:" the soles and palms were also of a lighter colour.

Although the general colour of the hair appears, at first sight, and when moist, to be almost black, it is not so, but is rather of a dusky grey: it is decidedly of a less deep tint than in the Chimpanzee (*Trogl. niger*): this is due to an admixture of a few reddish, and of more greyish hairs, with the dusky-coloured ones which chiefly constitute the "pelage": and the above admixture varies at different parts of the body. The reddish hairs are so numerous on the scalp, especially along the upper middle region, as to make their tint rather predominate there; they blend in a less degree with the long hairs upon the sides of the face. The greyish hairs are found mixed with the dusky upon the dorsal, deltoidal and anterior femoral regions; but, on the limbs, not in such proportion as to affect the impression of the general dark colour, at first view. The hairs are wavy, approaching to a woolly character. Near the margin of the vent are a few short whitish hairs, as in the Chimpanzee. The epiderm of the back showed the effects of habitual resting, with that part against the trunk or branch of a tree, occasioning the hair to be more or less rubbed off: the epiderm was here very thick and tough.

It is most probable, from the degree of admixture of different coloured hairs above described, that a living Gorilla seen in bright sunlight, would in some positions reflect from its surface a colour much more different from that of the Chimpanzee than appears by a comparison of the skin of a dead specimen sent home in spirits. It can hardly be doubted, also, that age will make an appreciable difference in the general coloration of the *Troglodytes gorilla*.

The adult male Gorilla measures five feet six inches from the sole to the top of the head, the breadth across the shoulders is nearly three feet, the length of the upper limb is three feet four inches,

that of the lower limb is two feet four inches; the length of the head and trunk is three feet six inches, whilst the same dimension in man does not average three feet.

In the foregoing remarks the author had given the results of direct observations made on the first and only entire specimen of the Gorilla which had reached England. At the period when they were made, no other description of its external characters had reached him; and if the majority of them be found to agree with previously recorded observations by naturalists enjoying earlier opportunities of studying similarly preserved specimens, the rarity and importance of the species might excuse, if it did not justify, a second description from direct scrutiny of a new specimen by an old observer of the anthropoid Quadrumana. A much more important labour, however, remained. The accurate record of facts in natural history was one and a good aim; the deduction of their true consequences was a better. Professor Owen proceeded, therefore, to reconsider the conclusions from which his experienced French and American fellow-labourers in natural history differed from him, and in which it seemed he stood alone.

The first—it may be called the supreme—question in regard to the Gorilla was, its place in the scale of nature, and its true and precise affinities.

Is it or not the nearest of kin to human kind? Does it form, like the Chimpanzee and Orang, a distinct genus in the anthropoid or knuckle-walking group of apes? Are these apes, or are the long-armed Gibbons, more nearly related to the genus *Homo*? Of the broad-breast-boned quadrumana, are the knuckle-walkers or the brachiators, *i.e.* the long-armed Gibbons, most nearly and essentially related to the human subject? The author proceeded to discuss the first as the most important question.

At the first aspect, whether of the entire animal or of the skeleton, he freely admitted that the Gorilla strikes the observer as being a much more bestial and brutish animal than the Chimpanzee. All the features that relate to the wielding of the strong jaws and large canines are exaggerated; the evidence of brain is less, its chamber is more masked by the outgrowth of the strong occipital and other cranial ridges. But the impression so made—that the Gorilla is less like Man—is the same which is derived from comparing a young with an adult Chimpanzee, or some small tailless monkey with a full-grown male Orang or Chimpanzee. Taking the characters that cause that impression at a first inspection of the Gorilla, most of the small South American monkeys are more anthropoid than it; they have a proportionally larger and more human-shaped cranium, much less prominent jaws, with more equable teeth.

Referring to the skeletons of the adult males of the Gorilla, Chimpanzee, Orang, and Gibbon, Professor Owen remarked that the globular cranium of the last, and its superior size compared with the jaws and teeth, seemed to show the Gibbons to be more nearly akin to man than are the larger tailless Apes. And this conclusion had been adopted by a distinguished French palæontologist, M. Lartet,

home*. They cite the experienced Professor of Human Anatomy at Amsterdam as supporting this view; but Prof. Owen had failed to find any statement of the grounds upon which it was sustained. In the art. *Quadrumana* of Todd's "Cyclopædia of Anatomy," cited by Lartet,† Prof. Vrolik briefly treats of the osteology of the *Quadrumana* according to their natural families. In "a first genus, *Simia* proper, or ape," he includes the Chimpanzee or Orang, noticing some of the chief points by which these apes approach the nearest to man. He next goes to "the second genus, the Gibbons" (*Hylobates*); he notices their ischial callosities, and the nearer approach of their molars, in their rounded form, to the teeth of *Carnivora* than the molars of the genus *Simia*. Then, comparing the Siamang with other species of *Hylobates*, Vrolik says, "its skeleton approaches most to that of man;" which may be true in comparison with other Gibbons, but certainly is not so as respects the higher *Simiæ*. No details are given to illustrate the proposition even in its more limited application; but the minor length of the arms in the Siamang, as compared with *Hylobates lar*, was probably the character in point.

The appearance of superior cerebral development in the Siamang and other long-armed apes is due to their small size and the concomitant feeble development of their jaws and teeth. The same appearance makes the small platyrrhine Monkeys of South America equally anthropoid in their facial physiognomy, and much more human-like than are the great Orangs and Chimpanzees. It is an appearance which depends upon the precocious growth of the brain as dependent on the law of its development. In all *Quadrumana* the brain has reached its full size before the second set of teeth is acquired, almost before the first set is shed. If, however, a young Gorilla, Chimpanzee, or Orang, be compared with a young Siamang of corresponding age, the absolutely larger size and better shape of brain, the deeper and more numerous convolutions of the cerebrum, and the more completely covered cerebellum in the former, unequivocally demonstrate the higher organization of the shorter-armed Apes. "In the structure of the brain," writes Vrolik,‡ in accordance with all other comparative anatomists, "they" (Chimpanzee and Orang-utan) "approach the nearest to man." The degree to which the Chimpanzee and Orang so resembled the human type seemed much closer to Cuvier, who knew those great apes only in their immaturity, with their small milk-teeth and precociously developed brain. Accordingly, the anthropoid characters of the *Simia satyrus* and *Simia troglodytes*, as deduced from the facial angle and dentition, are proportionally exaggerated in the "Règne Animal." § As growth proceeds, the milk-teeth are shed, the jaws expand, the great canines succeed their diminutive representatives, the temporal

* Lyell, Sir C. "Supplement to the Fifth Edition of a Manual of Elementary Geology," 1859, p. 15.

† "Comptes Rendus de l'Académie des Sciences, Juillet 28, 1856."

‡ Art. *Quadrumana*, "Cyclopædia of Anatomy," vol. iv. p. 195.

§ Ed. 1829, pp. 87, 89.

muscles gain a proportional increase of carneous fibres, their bony fulcra respond to the call for increased surface of attachment, the sagittal and occipital crests begin to rise; but the brain grows no more; its cranial box retains the size it showed in immaturity; it finally becomes masked by the superinduced osseous developments in those apes which attain the largest stature and wield the most formidably armed jaws. Yet under this show of physical force, the brain of both Orang and Chimpanzee is still the better and the larger, than is that of the little long-armed ape, which retains throughout life so much more of the characters of immaturity, especially in the structure of the skull.

The Siamang and other Gibbons have smaller, lower but longer upper canines, relatively, than in the Orangs and Chimpanzees; the permanent ones more quickly attain their full size, and are sooner in their place in the jaws; consequently the last molar teeth, *m* 3, come last into place as they do in the human species. But, if this be interpreted as of importance in determining the relative affinity of the longer-armed and shorter-armed apes to man, it is a character in which, as in their seeming superior cerebral development, the *Hylobates* agree with some much lower *Quadrumana* with still smaller canines.

The systematic zoologist, pursuing this most interesting comparison with clear knowledge of the true conditions and significance of a globular cranium and small jaws within the quadrumanous order, first determines and takes as his compass or guide-point the really distinctive characters of the human organization.

In respect to the cerebral test, he looks not so much for the relative size of the brain to the body, as for its relative size in the species compared one with another in the same natural group. He inquires what quadrumanous animal shows absolutely the biggest brain? what species shows the deepest and most numerous and winding convolutions? in which is the cerebrum largest, as compared with the cerebellum? If he finds all these characters highest in the Gorilla, he does not permit himself to be diverted from the just inference because the great size and surpassing physical power attained in that species mask the true data from obvious view.

The comparative anatomist would look to the cæcum and the ischial integument: if he found in one subject of his comparisons (*Troglodytes*) a long "appendix vermiformis cæci," as in man, but no "callosities,"—in another subject (*Hylobates*) the ischial callosities, but only a short rudiment of the cæcal appendix,—he would know which of the two tailless Apes were to be placed next "the Monkeys with ischial callosities and no vermiform appendix," and which of the two formed the closer link toward man. He would find that the anthropoid intestinal and dermal characters were associated with the absolutely larger and better developed brain in the Gorilla, Chimpanzee, and Orang; whilst the lower quadrumanous characters exhibited by the cæcum and nates were exhibited by the smaller-brained and longer-armed but rounder-skulled and shorter-jawed Gibbons.

Pursuing the comparison through the complexities of the bony framework, he might first glance at the more obvious proportions; and such, indeed, as would be given by the entire animal. The characteristics of the limbs in Man are their near equality of length, but the lower limbs are the longest. The arms in Man reach to below the middle of the thigh; in the Gorilla they nearly attain the knee; in the Chimpanzee they reach below the knee; in the Orang they reach the ankle; in the Siamang they reach the sole; in most Gibbons the whole palm can be applied to the ground without the trunk being bent forward beyond its naturally inclined position on the legs. These gradational differences coincide with other characters determining the relative proximity to Man of the apes compared. In no Quadrumana does the humerus exceed the ulna so much in length as in Man; only in the most anthropoid, viz. the Gorilla and Chimpanzee, does it exceed the ulna at all in length; in the rest, as in the lower quadrupeds, the fore-arm is longer than the arm.

The humerus, in the Gorilla, though less long, compared with the ulna, than in Man, is longer than in the Chimpanzee; in the Orang it is shorter than the ulna; in the Siamang and other Gibbons it is much shorter, the peculiar length of arm in those "long-armed" apes is chiefly due to the excessive length of the antibrachial bones.

The difference in the length of the upper limbs, as compared with the trunk, is but little between Man and the Gorilla. The elbow-joint in the Gorilla, as the arm hangs down, is opposite the "labrum ilii," the wrist opposite the "tuber ischii;" it is rather lower down in the Chimpanzee; it is opposite the knee-joint in the Orang; it is opposite the ankle-joint in the Siamang.

Man's perfect hand is one of his peculiar physical characters; that perfection is mainly due to the extreme differentiation of the first from the other four digits, and its concomitant power of opposing them as a perfect thumb. An opposable thumb is present in the hand of most *Quadrumana*, but is usually a small appendage compared with that of Man. It is relatively largest in the Gorilla. In this ape the thumb reaches to a little beyond the base of the first phalanx of the fore-finger; it does not reach to the end of the metacarpal bone of the fore-finger in the Chimpanzee, Orang, or Gibbon; it is relatively smallest in the last tailless ape. In Man the thumb extends to or beyond the middle of the first phalanx of the fore-finger. The philosophical zoologist will see great significance in the results of this comparison. Only in the Gorilla and Chimpanzee are the carpal bones eight in number, as in man; in the Orangs and Gibbons they are nine in number, as in the tailed monkeys.

The scapulæ are broader in the Gorilla than in the Chimpanzee, Orang, or long-armed apes; they come nearer to the proportions of that bone in Man. But a more decisive resemblance to the human structure is presented by the iliac bones. In no other ape than the Gorilla do they bend forward, so as to produce a pelvic concavity; nor are they so broad in proportion to their length in any ape as in the Gorilla. In both the Chimpanzee and Orang the iliac bones are

flat, or present a concavity rather at the back than at the fore part. In the Siamang they are not only flat, but are narrower and longer, resembling the iliac bones of tailed monkeys and ordinary quadrupeds.

The lower limbs, though characteristically short in the Gorilla, are longer in proportion to the upper limbs, and also to the entire trunk, than in the Chimpanzee; they are much longer in both proportions and more robust than in the Orangs or Gibbons. But the guiding points of comparisons here are the heel and the hallux.

The heel in the Gorilla makes a more decided backward projection than in the Chimpanzee; the heelbone is relatively thicker, deeper, more expanded vertically at its hind end, beside being fully as long as in the Chimpanzee: it is in the Gorilla shaped and proportioned more like the human calcaneum than in any other ape. Among all the tailless apes the calcaneum in the Siamang and other Gibbons least resembles in its shape or proportional size that of Man.

Although the foot be articulated to the leg with a slight inversion of the sole it is more nearly plantigrade in the Gorilla than in the Chimpanzee. The Orang departs far, and the Gibbons farther, from the human type in the inverted position of the foot.

The great toe which forms the fulcrum in standing or walking is, perhaps, the most characteristic peculiarity in the human structure; it is that modification which differentiates the foot from the hand, and gives the character to the order *Bimana*. In the degree of its approach to this development of the hallux the quadrumanous animal makes a true step in affinity to Man.

The Orang-utan and the Siamang, tried by this test, descend far and abruptly below the Chimpanzee and Gorilla in the scale. In the Orang the hallux does not reach to the end of the metacarpal of the second toe; in the Chimpanzee and Gorilla it reaches to the end of the first phalanx of the second toe; but in the Gorilla the hallux is thicker and stronger than in the Chimpanzee. In both, however, it is a true thumb, by position, diverging from the other toes, in the Gorilla, at an angle of 60° from the axis of the foot.

Man has twelve pairs of ribs, the Gorilla and Chimpanzee have thirteen pairs, the Orangs have twelve pairs, the Gibbons have thirteen pairs. Were the naturalist to trust to this single character, as some have trusted to the cranio-facial one, and in equal ignorance of the real condition and value of both, he might think that the Orangs (*Pithecus*) were nearer akin to man than the Chimpanzees (*Troglodytes*) are. But man has sometimes a thirteenth pair of ribs; and what we term "ribs" are but vertebral elements or appendages common to nearly all the true vertebræ in man, and only so called, when they become long and free. The genera *Homo*, *Troglodytes*, and *Pithecus*, have precisely the same number of vertebræ; if *Troglodytes*, by the development and mobility of the pleurapophyses of the twentieth vertebra from the occiput, seem to have an additional thoracic vertebra, it has one vertebra less in the lumbar region. So, if there be, as has been observed, a difference in the number of sacral vertebræ, it is merely due to a last lumbar having coalesced with what we reckon as the first sacral vertebra in Man.

The thirteen pairs of ribs, therefore, in the Gorilla and Chimpanzee, are of no weight, as against the really important characters significative of affinity with the human type. But, supposing the fact of any real value, how do the advocates of the superior resemblance of the Siamang's or Gibbon's skeleton to that of man dispose of the thirteenth pair of ribs?

In applying the characters of the skull to the determination of the important question at issue, those must first be ascertained by which the genus *Homo* trenchantly differs from the genus *Simia*, of Linnæus. To determine these osteal distinctions, the author stated that he had compared the skulls of many individuals of different varieties of the human race together with those of the male, female, and young of species of *Troglodytes*, *Pithecus*, and *Hylobates*; Professor Owen referred to his 'Catalogue of the Osteological Series in the Museum of the Royal College of Surgeons,' 4to, 1853, for the detailed results of these comparisons. On the present occasion he would restrict himself to a few of these results.

The first and most obvious differential character is the globular form of the brain-case, and its superior relative size to the face, especially the jaws, in man. But this, for the reasons he had already assigned, is not an instructive or decisive character, when comparing quadrumanous species, in reference to the question at issue. It is exaggerated in the human child, owing to the acquisition of its full, or nearly full size, by the brain, before the jaws have expanded to lodge the second set of teeth. It is an anthropoid character in which the Quadrumana resemble man, in proportion to the diminution of their general bulk. If a Gorilla, with milk-teeth, have a somewhat larger brain and brain-case than a Chimpanzee at the same immature age, the acquisition of greater bulk by the Gorilla, and of a more formidable physical development of the skull, in reference to the great canines in the male, will give to the Chimpanzee the appearance of a more anthropoid character, which really does not belong to it,—which could be as little depended upon in a question of precise affinity as the like more anthropoid characters of the female, as compared with the male, Gorilla or Chimpanzee.

Much more important and significant were the following characters of the human skull:—the position and plane of the occipital foramen; the proportional size of the condyloid and petrous processes; the mastoid processes, which relate to balancing the head upon the trunk in the erect attitude; the small premaxillaries and concomitant small size of the incisor teeth, as compared with the molar teeth. The latter character relates to the superiority of the psychical over the physical powers in man: it governs the feature in which man recedes from the brute; as does also the prominence of the nasal bones in most, and in all the typical, races of man. The somewhat angular form of the bony orbits, tending to a square, with the corners rounded off, is a good human character of the skull, which is difficult to comprehend as an adaptive one, and therefore the better in the present inquiry. The same may be said of the production of the floor of the tympanic or auditory tube into the plate called "vaginal."

Believing the foregoing to be sufficient to test the respective degrees of affinity to man within the limited group of Quadrumana to which it was proposed, in the present memoir, to apply them, the author would not dilute his argument by citing minor characters. The question at issue was the respective degrees of affinity as between the anthropoid apes and man. Cuvier deemed the Orang (*Pithecus*) to be nearer akin to man than the Chimpanzee (*Troglodytes*) is. That belief has long ceased to be entertained. Professor Owen proceeded, therefore, to compare the Gorilla, Chimpanzee, and Gibbon, in reference to their human affinities.

Most naturalists entering upon this question would first look to the premaxillary bones, or, owing to the early confluence of those bones with the maxillaries in the Gorilla and Chimpanzee, to the part of the upper jaw containing the incisive teeth, on the size and direction of which depends the prognathic or brutish character of a skull. Now the extent of the premaxillaries below the nostril is not only relatively but absolutely less in the Gorilla, and consequently the profile of the skull is less convex at this part, or less "prognathic" than in the Chimpanzee. Notwithstanding the degree in which the skull of the Gorilla surpasses in size that of the Chimpanzee, especially when the two are compared on a front view, the breadth of the premaxillaries and of the four incisive teeth is the same in both. In the relative degree, therefore, in which these bones are smaller than in the Chimpanzee, the Gorilla, in this most important character, comes nearer to Man. In the Gibbons the incisors are relatively smaller than in the Gorilla, but the premaxillaries bear the same proportional size in the adult male Siamang.

Next, as regards the nasal bones. In the Chimpanzee, as in the Orangs and Gibbons, they are as flat to the face as in any of the lower *Simiæ*. In the Gorilla, the median coalesced margins of the upper half of the nasal bones are produced forward, in a slight degree it is true, but affording a most significant evidence of nearer resemblance to Man. In the same degree they impress that anthropic feature upon the face of the living Gorilla. In some pig-faced baboons there are ridges and prominences in the naso-facial part of the skull, but they do not really affect the question as between the Gorilla and Chimpanzee. All naturalists know that the Semnopitheques of Borneo have long noses, but the proboscidiform appendage which gives so ludicrous a mask to those monkeys is unaccompanied by any such modification of the nose-bones as gives the true anthropoid character to the human skull, and to which only the Gorilla, in the ape tribe, makes any approximation.

No Orang, Chimpanzee, or Gibbon shows any rudiment of mastoid processes; but they are present in the Gorilla, smaller indeed than in Man, but unmistakeable; they are, as in Man, cellular, pneumatic, and with a thin outer plate of bone. This fact led the author, in a former memoir, to express, when, in respect to the Gorilla, only the skull had reached him, the following inference, viz.: "from the nearer approach which the Gorilla makes to Man in comparison with the Chimpanzee or Orang, in regard to the mastoid processes, that it assumed more nearly and more habitually the

upright attitude than those inferior anthropoid apes do."* This inference has been fully borne out by the rest of the skeleton of the Gorilla, subsequently acquired.

In the Chimpanzee, as in the Orangs, Gibbons, and inferior *Simiæ*, the lower surface of the long tympanic or auditory process is more or less flat and smooth, developing in the Chimpanzee only a slight tubercle, anterior to the stylohyal pit. In the Gorilla the auditory process is more or less convex below, and developes a ridge, answering to the vaginal process, on the outer side of the carotid canal.. The processes posterior and internal to the glenoid articular surface are better developed, especially the internal one, in the Gorilla than in the Chimpanzee; the ridge which extends from the ectopterygoid along the inner border of the foramen ovale, terminates in the Gorilla by an angle or process answering to that called "styliform" or "spinous" in Man, but of which there is no trace in the Chimpanzee, Orang, or Gibbon.

The orbits have a full oval form in the Orang; they are almost circular in the Chimpanzee and Siamang, more nearly circular, and with a more prominent rim in the smaller Gibbons; in the Gorilla alone do they present the form which used to be deemed peculiar to man. There is not much physiological significance in some of the latter characters, but on that very account, the author deemed them more instructive and guiding in the actual comparison. The occipital foramen is nearer the back part of the cranium, and its plane is more sloping, less horizontal in the Siamang than in the Chimpanzee and Gorilla. Considering the less relative prominence of the fore-part of the jaws in the Siamang, as compared with the Chimpanzee, the occipital character of that Gibbon and of other species of *Hylobates* marks well their inferior position in the quadrumanous scale.

In the greater relative size of the molars, compared with the incisors, the Gorilla makes an important closer step towards Man than does the Chimpanzee. The molar teeth are relatively so small in the Siamang, that, notwithstanding the small size of the incisors, the proportion of those teeth to the molars is only the same as in the Gorilla: in other Gibbons (*Hylobates lar*), the four lower incisors occupy an extent equal to that of the first four molars, in the Chimpanzee equal to that of the first three molars, in the Siamang equal to that of the first two molars and rather more than half of the third, in Man equal to the first two molars and half of the third: in this comparison the term molar is extended to the bicuspids.

The proportion of the ascending ramus to the length of the lower jaw tests the relative affinity of the tailless apes to Man.

In a profile of the lower jaw, the author compares the line drawn vertically from the top of the coronoid process to the horizontal length along the alveoli. In Man and the Gorilla it is about $\frac{7}{10}$ths, in the Chimpanzee $\frac{6}{10}$ths, in the Siamang it is only $\frac{4}{10}$ths. The Siamang further differs in the shape and production of the angle of the jaw, and in the shape of the coronoid process, approaching the lower *Simiæ*

* Transactions of the Zoological Society, vol. iii. p. 409.

in both these characters. In the size of the post-glenoid process, in the shape of the glenoid cavity which is almost flat, in the proportional size of the petrous bone, and in the position of the foramen caroticum, the Siamang departs further from the human type, and approaches nearer that of the tailed *Simiæ*, than the Gorilla does, and in a marked degree.

Every legitimate deduction from a comparison of cranial characters makes the tailless Quadrumana recede from the human type in the following order:—Gorilla, Chimpanzee, Orangs, Gibbons, and the last named in a greater and more decided degree.

These comparisons have of late been invested with additional interest from the discoveries of remains of quadrumanous species in different members of the tertiary formations.

The first quadrumanous fossil, the discovery of which by Lieuts. Baker and Durand is recorded in the 'Journal of the Asiatic Society of Bengal,' for November, 1836, has proved to belong, like subsequently discovered quadrumanous fossils in the Sewalik (probably miocene) tertiaries, to the Indian genus *Semnopithecus*. The quadrumanous fossils discovered in 1839, in the eocene deposits of Suffolk, belong to a genus (*Eopithecus*) having its nearest affinities with *Macacus*. The monkey's molar tooth from the pliocene beds of Essex is most closely allied to the *Macacus sinicus*. The remains of the large monkey, four feet in height, discovered in 1839 by Dr. Lund in a limestone cavern in Brazil was shown by its molar dentition $\left(p\,\frac{3-3}{3-3},\ m\,\frac{3-3}{3-3}\right)$ to belong to the platyrrhine family now peculiar to South America. The lower jaw and teeth of the small quadrumane discovered by M. Lartet in a miocene bed of the South of France, and described by him and De Blainville, are so closely allied to the Gibbons, as scarcely to justify the generic separation which has been made for it under the name *Pliopithecus*.

Finally, a portion of a lower jaw with teeth and the shaft of a humerus of a quadrumanous animal (*Dryopithecus*), equalling the size of those bones in Man, have been discovered by M. Fontan, of Saint-Gaudens, in a marly bed of Upper Miocene age, forming the base of the plateau on which that town is built. The molar teeth present the type of grinding surface of those of the Gibbons (*Hylobates*), and, as in that genus, the second true molar is larger than the first, not of equal size, as in the human subject and Chimpanzee. The premolars have a greater antero-posterior extent, relatively, than in the Chimpanzee, and in this respect agree more with those in the Siamang. The first premolar has the outer cusp raised to double the height of that of the second; its inner lobe appears from M. Lartet's figure to be less developed than in the Gorilla, certainly less than in the Chimpanzee. The posterior talon of the second premolar is more developed, and consequently the fore and aft extent of the tooth is greater than in the Chimpanzee; thereby the second premolar of *Dryopithecus* more resembles that in *Hylobates*, and departs further from the human type.

The canine, judging from the figures published by M. Lartet*,

* 'Comptes Rendus de l'Académie des Sciences.' Paris, vol. xliii.

seems to be less developed than in the male Chimpanzee, Gorilla, or Orang; in which character the fossil, if it belonged to a male, makes a nearer approach to the human type: but it is one which many of the inferior monkeys also exhibit, and is by no means to be trusted as significant of true affinity, supposing even the sex of the fossil to be known as being male.

The shaft of the humerus, found with the jaw, is peculiarly rounded, as it is in the Gibbons and Sloths, and offers none of those angularities and ridges which make the same bone in the Chimpanzee and Orang come so much nearer in shape to the humerus of the human subject. The fore part of the jaw, as in the Siamang, is more nearly vertical than in the Gorilla or Chimpanzee; but whether the back part of the jaw may not have departed in a greater degree from the human type than the fore part approaches it, as is the case in the Siamang, the state of the fossil does not allow of determining. One significant character is, however, present,—the shape of the fore part of the coronoid process. It is slightly convex forwards, which causes the angle it forms with the alveolar border to be less open. The same character is present in the Gibbons. The front margin of the lower half of the coronoid process in Man is concave, as it is likewise in the Gorilla and Chimpanzee. Prof. Owen was acquainted with this interesting fossil, referred to a genus called *Dryopithecus*, only by the figures published in the 43rd volume of the 'Comptes Rendus de l'Académie des Sciences.' From these it appears that the canine, two premolars, and first and second true molars, are in place; the socket of the third molar is empty, but widely open above; from which the author concludes that the third molar had also cut the gum, the crown being completed, but not the fangs. If the last molar had existed as a mere germ, it would more probably have been preserved in the substance of the jaw.

In a young Siamang, with the points of the permanent canines just protruding from the socket, exhibited by Prof. Owen, the crown of the last molar was complete, and on a level with the base of that of the penultimate molar; whence he inferred that the last molar would have cut the gum as soon as, if not before, the crown of the canine had been completely extricated. This dental character, the conformation and relative size of the grinding teeth, especially the fore and aft extent of the premolars, all indicate the close affinity of the *Dryopithecus* with the *Pliopithecus* and existing Gibbons; and this, the sole legitimate deduction from the maxillary and dental fossils, is corroborated by the fossil humerus, fig. 9, in the above-cited plate.

There is no law of correlation, by which, from the portion of jaw with teeth of the *Dryopithecus*, can be deduced the shape of the nasal bones and orbits, the position and plane of the occipital foramen, the presence of mastoid and vaginal processes, or other cranial characters determinative of affinity to Man; much less any ground for inferring the proportions of the upper to the lower limbs, of the humerus to the ulna, of the pollex to the manus, or the shape and development of the iliac bones. All those characters which do determine the closer resemblance and affinity of the genus *Troglodytes*

to man, and of the genus *Hylobates* to the tailed monkeys, are at present unknown in respect of the *Dryopithecus*. A glance at fig. 5 (*Gorilla*), and fig. 7 (*Dryopithecus*), of the plate of M. Lartet's memoir, would suffice to teach their difference of bulk, the Gorilla being fully one-third larger. The statement that the parts of the skeleton of the *Dryopithecus* as yet known, viz. the two branches of the lower jaw and the humerus, "are sufficient to show that in anatomical structure, as well as stature, it came nearer to man than any quadrumanous species, living or fossil, before known to zoologists *," is without the support of any adequate fact, and in contravention of most of those to be deduced from M. Lartet's figures of the fossils. Those parts of the *Dryopithecus* merely show—and the humerus in a striking manner—its nearer approach to the Gibbons; the most probable conjecture being that it bore to them, in regard to size, the like relations which Dr. Lund's *Protopithecus* bore to the existing *Mycetes*. Whether, therefore, strata of such high antiquity as the miocene may reveal to us "forms in any degree intermediate between the Chimpanzee and man" awaits an answer from discoveries yet to be made; and the anticipation that the fossil world "may hereafter supply new osteological links between man and the highest known Quadrumana †" must be kept in abeyance until that world has furnished us with the proofs that a species did formerly exist which came as near to man as does the Orang, the Chimpanzee, or the Gorilla.

Of the nature and habits of the last-named species, which really offers the nearest approach to man of any known ape, recent or fossil, the author had received many statements from individuals resident at or visitors to the Gaboon, from which he selected the following as most probable, or least questionable.

Gorilla-land is a richly-wooded extent of the western part of Africa, traversed by the rivers Danger and Gaboon, and extending from the equator to the 10th or 15th degree of south latitude. The part where the Gorilla has been most frequently met with presents a succession of hill and dale, the heights crowned with lofty trees, the valleys covered by coarse grass, with partial scrub or scattered shrubs. Fruit trees of various kinds abound both on the hills and in the valleys; some that are crude and uncared for by the Negros are sought out and greedily eaten by the Gorillas; and as different kinds come to maturity at different seasons, they afford the great denizen of the woods a successive and unfailing supply of indigenous fruits. Of these Professor Owen specified the following sources:—

The palm-nut (*Elais guiniensis*) of which the Gorillas greatly affect the fruit and upper part of the stipe, called the "cabbage." The Negroes of the Gaboon have a tradition that their forefathers first learnt to eat the "cabbage," from seeing the Gorilla eat it, concluding that what was good for him must be good for man.

The "ginger-bread tree" (*Parinarium excelsum*), which bears a plum-like fruit.

* Lyell (Sir Charles), 'Supplement to the Fifth Edition of Manual of Elementary Geology,' 8vo, 1859, p. 14. † Ibid.

The papau tree (*Carica papaya*).

The banana (*Musa sapientium*), and another species (*Musa paradisiaca*).

The *Amomum Afzelii* and *Am. grandiflorum*.

A tree, with a shelled fruit, like a walnut, which the Gorilla breaks open with the blow of a stone.

A tree, also botanically unknown, with a fruit like a cherry.

Such fruits and other rich and nutritious productions of the vegetable kingdom, constitute the staple food of the Gorilla, as they do of the Chimpanzee. The molar teeth, which alone truly indicate the diet of an animal, accord with the statements as to the frugivorous character of the Gorilla: but they also sufficiently answer to an omnivorous habit to suggest that the eggs and callow brood of nests discovered in the trees frequented by the Gorilla might not be unacceptable.

The Gorilla makes a sleeping place like a hammock, connecting the branches of a sheltered and thickly-leaved part of a tree by means of the long tough slender stems of parasitic plants, and lining it with the broad dried fronds of palms, or with long grass. This hammock-like abode may be seen at different heights, from 10 to 40 feet from the ground, but there is never more than one such nest in a tree.

They avoid the abodes of man, but are most commonly seen in the months of September, October, and November, after the negroes have gathered their outlying rice-crops, and have returned from the "bush" to the village. So observed, they are described to be usually in pairs; or, if more, the addition consists of a few young ones, of different ages, and apparently of one family. The Gorilla is not gregarious. The parents may be seen sitting on a branch, resting the back against the tree-trunk—the hair being generally rubbed off the back of the old Gorilla from that habit—perhaps munching fruit, whilst the young Gorillas are at play, leaping and swinging from branch to branch, with hoots or harsh cries of boisterous mirth.

If the old male be seen alone, or when in quest of food, he is usually armed with a stout stick, which the negroes aver to be the weapon with which he attacks his chief enemy the elephant. Not that the elephant directly or intentionally injures the Gorilla, but, deriving its subsistence from the same source, the ape regards the great proboscidian as a hostile intruder. When, therefore, he discerns the elephant pulling down and wrenching off the branches of a favourite tree, the Gorilla, stealing along the bough, strikes the sensitive proboscis of the elephant with a violent blow of his club, and drives off the startled giant trumpeting shrilly with rage and pain.

In passing from one detached tree to another, the Gorilla is said to walk semi-erect, with the aid of his club, but with a waddling awkward gait; when without a stick, he has been seen to walk as a biped, with his hands clasped across the back of his head, instinctively so counterpoising its forward projection. If the Gorilla be surprised and approached while on the ground, he drops his stick, betakes himself to all-fours, applying the back part of the bent

knuckles of his fore-hands to the ground, and makes his way rapidly, with an oblique swinging kind of gallop, to the nearest tree. There he awaits his pursuer, especially if his family be near, and requiring his defence. No negro willingly approaches the tree in which the male Gorilla keeps guard. Even with a gun the experienced negro does not make the attack, but reserves his fire in self-defence. The enmity of the Gorilla to the whole negro race, male and female, is uniformly attested.

The young men of the Gaboon tribe make armed excursions into the forests, in quest of ivory. The enemy they most dread on these occasions is the Gorilla. If they have come unawares too near him with his family, he does not, like the lion, sulkily retreat, but comes rapidly to the attack, swinging down to the lower branches, and clutching at the nearest foe. The hideous aspect of the animal, with his green eyes flashing with rage, is heightened by the skin over the prominent roof of the orbits being drawn rapidly backward and forward, with the hair erected, causing a horrible and fiendish scowl. If fired at and not mortally hit, the Gorilla closes at once upon his assailant, and inflicts most dangerous, if not deadly wounds, with his sharp and powerful tusks. The commander of a Bristol trader told the author he had seen a negro at the Gaboon frightfully mutilated by the bite of the Gorilla, from which he had recovered. Another negro exhibited to the same voyager a gun-barrel bent and partly flattened by the bite of a wounded Gorilla, in its death-struggle. Negroes, when stealing through the gloomy shades of the tropical forest, become sometimes aware of the proximity of one of these frightfully formidable apes by the sudden disappearance of one of their companions, who is hoisted up into the tree, uttering, perhaps, a short choking cry. In a few minutes he falls to the ground a strangled corpse. The Gorilla, watching his opportunity, has let down his huge hind-hand, seized the passing negro by the neck, with vice-like grip, has drawn him up to higher branches, and dropped him when his struggles had ceased.

The strength of the Gorilla is such as to make him a match for a lion, whose tusks his own almost rival. Over the leopard, invading the lower branches of the Gorilla's dwelling-tree, he will gain an easier victory; and the huge canines, with which only the male Gorilla is furnished, doubtless have been assigned to him for defending his mate and offspring.

The skeleton of the old male Gorilla obtained for the British Museum in 1857, shows an extensive fracture, badly united, of the left arm-bone, which has been shortened, and gives evidence of long suffering from abscess and partial exfoliation of bone. The upper canines have been wrenched out or shed some time before death, for their sockets have become absorbed.

The redeeming quality in this fragmentary history of the Gorilla is the male's care of his family, and the female's devotion to her young.

It is reported that a French natural-history collector, accompanying a party of the Gaboon negroes into the Gorilla woods, surprised a female with two young ones on a large boabdad (*Adansonia*), which

stood some distance from the nearest clump. She descended the tree with her youngest clinging to her neck, and made off rapidly on all fours to the forest, and escaped. The deserted young one on seeing the approach of the men began to utter piercing cries: the mother, having disposed of her infant in safety, returned to rescue the older offspring, but before she could descend with it her retreat was cut off. Seeing one of the negroes level his musket at her, she, clasping her young with one arm, waved the other, as if deprecating the shot: the ball passed through her heart, and she fell with her young one clinging to her. It was a male, and survived the voyage to Havre, where it died on arriving. Professor Owen had examined the skeleton of this young Gorilla in the museum of natural history at Caen, and was indebted to Professor Deslongchamps, Dean of the Faculty of Sciences in that town, for drawings of the skeleton of this rare specimen.

There might be more difficulty in obtaining a young Gorilla for exhibition than a young Chimpanzee; but as no full-grown Chimpanzee has ever been captured, we cannot expect the larger and much more powerful adult Gorilla to be ever taken alive. A bold negro, the leader of an elephant-hunting expedition, being offered a hundred dollars if he would bring back a live Gorilla, replied, "If you gave me the weight of yonder hill in gold coins, I could not do it!"

All the terms of the aborigines in reference to the Gorilla imply their opinion of his close kinship to themselves. But they have a low opinion of his intelligence. They say that during the rainy season he builds a house without a roof. The natives on their hunting excursions light fires for their comfort and protection by night; when they have gone away, they affirm that the Gorilla will come down and warm himself at the smouldering embers, but has not wit enough to throw on more wood, out of the surrounding abundance, to keep the fire burning,—"the stupid old man!"

Every account of the habits of a wild animal obtained at second hand from the reports of aborigines has, commonly, its proportion of "apocrypha." The author had restricted himself to the statements that had most probability and were in accordance with the ascertained structures and powers of the animal, and would only add the averment and belief of the Gaboon negroes, that when a Gorilla dies, his fellows cover the corpse with a heap of leaves and loose earth collected and scraped up for the purpose.

A most singular phenomenon in natural history, if one reflects on the relations of things, is this Gorilla! Limited as it is in its numbers and geographical range, one discerns that the very peculiar conditions of its existence—abundance of wild fruit—needs must be restricted in space; but concurring in a certain part of Africa, there lives the creature to enjoy them.

The like conditions exist in Borneo and Sumatra, and there also a correlative human-like ape, of similar nature, tooth-armour, and force, exists at their expense. Neither Ourangs nor Gorillas however minister to man's use either directly or indirectly. Were they to become extinct, no sign of the change or break in the links of life would remain. What may be their real significance?

Reverting finally to the ancient notices which might relate to the great anthropoid ape of Africa, Prof. Owen referred to his first Memoir, of February, 1848, in which was quoted (Trans. Zool. Soc., vol. iii. p. 418) Dr. Falconer's 'Translation of the Voyage of Hanno,' (London, 1797) with his dissertation vindicating the authenticity of the "Periplus." Professor Owen had lately been favoured by the venerable Bishop Maltby, the first amongst our Greek scholars, with the following translation of the passage supposed to allude to the species in question:—"On the third day, having sailed from thence, passing the streams of fire, we came to a bay called the Horn of the South. In the recess there was an island like the first, having a lake, and in this there was another island full of wild men. But much the greater part of them were women, with hairy bodies, whom the interpreters called 'Gorillas.' But, pursuing them, we were not able to take the men; they all escaped, being able to climb the precipices, and defended themselves with pieces of rock. But three women (females), who bit and scratched those who led them, were not willing to follow. However, having killed them, we flayed them, and conveyed the skins to Carthage; for we did not sail any further, as provisions began to fail." This encounter indicates, therefore, the southernmost point on the west coast of Africa reached by the Carthaginian navigator.

To the inquiry by Bishop Maltby, how far the newly-discovered great ape of Africa bore upon the question of the authenticity of the Periplus, Prof. Owen had replied:—"The size and form of the great ape, now called 'Gorilla,' would suggest to Hanno and his crew no other idea of its nature than that of a kind of human being; but the climbing faculty, the hairy body, and skinning of the dead specimens, strongly suggest that they were large anthropoid apes. The fact that such apes, having the closest observed resemblance to the negro, being of human stature and with hairy bodies, do still exist on the west coast of Africa, renders it highly probable that such were the creatures which Hanno saw, captured, and called 'Gorullai.'"

The brief observation made by Battell in west tropical Africa, 1590, recorded in Purchas's "Pilgrimages, or Relations of the World," 1748, of the nature and habits of the large human-like ape which he calls "Pongo," more decidedly refers to the Gorilla. Other notices, as by Nieremberg and Bosman, applied by Buffon to Battell's Pongo, were deemed valueless by Cuvier, who altogether rejected the conclusions of his great predecessor as to the existence of any such ape. "This name of Pongo or Boggo, given in Africa to the Chimpanzee or to the Mandril, has been applied," writes Cuvier, "by Buffon to a pretended great species of Ourang-utan, which was nothing more than the imaginary product of his combinations." After the publication of Cuvier's 'Règne Animal,' the supposed species was, by the high authority of its author, banished from natural history; it has only been authentically reintroduced since the intelligent attention of Dr. Savage was directed to the skull which he first saw at the Gaboon in 1847, and took Professor Owen's opinion upon.

MISCELLANEOUS.

On Pelamys Sarda, *a British Fish.* By Dr. J. E. Gray, F.R.S. &c.

Mr. W. Beattie, Secretary of the Montrose Natural History and Antiquarian Society, has sent me the following description and a photograph of a specimen of *Pelamys Sarda*, which was captured in a bag (salmon-) net at the mouth of the North Esk, in June last (1859). There is no doubt of its being *Pelamys Sarda*, from the figure. Mr. Beattie observes that "the *Pelamys Sarda* figured by Yarrell as a vignette to his article on *Bonito* resembles the Esk *Scomber* very closely, except in the oblique bars, which in his figure are broad and transverse." I may observe that the specimen taken at the Esk is only 4 inches shorter than that described by M. Valenciennes as taken on the coast of Canary by Webb and Berthelot, and is larger than the ordinary size of the Mediterranean specimens, according to the observation of Sir John Richardson.

Pelamys Sarda.

Description of Specimen.—"Length from the point of the nose to the centre of the tail, which is crescent-shaped, 21 inches; extreme, $22\frac{1}{2}$ in. Girth, at thickest, 12 inches. Weight 4 lb. 6 oz. From the centre of the eye to the point of the nose $2\frac{1}{4}$ inches. From the centre of the eye to the origin of the branchial fin, $3\frac{1}{4}$ inches. Expanse of tail $4\frac{3}{4}$ inches. Space between pectoral and anal fins 8 in. From first dorsal fin to point of nose $5\frac{1}{2}$ inches. Body round, tapering from the vent to the tail.

"A triangular space behind and above the gill-opening, and including the origin of the branchial fin, covered with projecting scales larger than those on other parts of the body. From the upper and anterior angle of this space, several rows of prominent scales extend backward along each side of the front dorsal, and converge toward the second dorsal fin. Lateral line waved till opposite the termination of the anal fin, when it runs in a straight line to the tail.

D. $\frac{22}{13}$ VIII. or IX.

"Origin of dorsal fin behind origin of pectoral. Ten dark bars run obliquely forward from the back at an angle of 30°.

"Upper jaw and teeth project over the lower jaw. Teeth conical, curved inwards, those in the lower jaw larger. Front teeth in upper jaw short. Two teeth in front of each lower jaw bent backwards; these, with the larger ones on the side, measure $\frac{1}{6}$ inch in length. On the sides of the lower jaw the long teeth alternate with smaller ones.—Wm. B."

Occurrence of the Rufous Sedge Warbler in South Devon.

A second specimen of the Rufous Sedge Warbler (*Aedon galactotes*) has been killed near Start Point, South Devonshire, on the 25th of September last. It was shot by William D. Llewellyn, Esq., by whom it was presented to the British Museum. That gentleman observed that its flight much resembled that of a Lark, and that it was exceedingly thin. Its visit was probably occasioned by the strong southerly wind which had prevailed for several days. The

former specimen of this rare bird, which Mr. Yarrell figured in his second Supplement to the 'History of British Birds,' was obtained on the downs near Brighton, in the autumn of 1854.—G. R. G.

*On the New British Snake**. By Dr. J. E. Gray, F.R.S. &c.

Mr. Bond has presented to the British Museum a fine large specimen of *Coronella austriaca,* which he took when searching for *Lacerta Stirpium* at St. Leonard's, near Ringwood, in the New Forest, in the year 1854. He always considered it as distinct; but several of his friends regarded it as only a variety of the young collared snake, *Tropidonotus Natrix.*

On a new species of Catharus. By P. L. Sclater, M.A., F.L.S.

CATHARUS OCCIDENTALIS.

Cinnamomeo-brunneus, vertice saturatiore: subtus cineraceus, gula albicante, cervice et pectore fusco subobsolete flammulatis: ventre medio et crisso albis: rostro fusco-nigricante, hujus basi et pedibus pallide corylinis.

Long. tota 6·5, alæ 3·5, caudæ 2·9, tarsi 1·15.

Hab. Western Mexico, Oaxaca, Totontepec (*Boucard*).

M. Sallé's recent collections from M. Boucard contain four examples of this *Catharus.* It seems clearly distinct from *C. Melpomene* of Eastern Mexico, in its rather larger size, shorter tarsi, and spotted neck and breast; these parts in *C. Melpomene* being immaculate.—*Proc. Zool. Soc.* June 28, 1859.

Prize Questions.

The following questions have been submitted to competition by the Utrecht Society of Arts and Sciences:—

1. Inquiries into the development of one or more species of the Mollusca, Annelides, or Crustacea, an account of which has not yet been written, with figures illustrative of the text.
2. A series of researches on the heat generated by plants

A gold medal of the value of 30 ducats (£13 st.), or an equivalent in silver, will be awarded to each successful competitor. The answers to the first question must be sent in (post free) previous to the 30th of Nov. 1860—to the second, before the 30th of Nov. 1861, addressed to Dr. J. W. Gunning, the Secretary of the Society at Utrecht. The author is at liberty to avail himself either of the Dutch, German (in Roman characters), English, French, or Latin language; but the answers must not be in his own hand-writing. They are to be accompanied by a sealed envelope, enclosing his name, and, if a member of the Society, having the letter "L" on the address. The successful answers will be published in the Society's works.

Further information may be obtained on application to the Secretary of the Society.

* The reader is requested to make the following correction in the former notice: p. 317, line 3 from the bottom, *for* smooth sides *read* smooth scales.—Ed.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 24. DECEMBER 1859.

XL.—*On the Forms and Structure of Fern-stems.* By George Ogilvie, M.D., Lecturer on the Institutes of Medicine in Marischal College and University, Aberdeen*.

[With three Plates.]

On the Vegetative Axis of Ferns.—For the following observations the author makes no further claim to originality than that they were suggested to him by researches which he was led to undertake from finding the subject scarcely noticed at all in our common botanical works.

External Characters of Fern-stems.

By the corm or vegetative axis of Ferns, it is hardly necessary to mention, is meant that part which, in our indigenous species, is commonly termed the *root*, as being more or less buried in the soil, though it does not differ essentially from the arborescent stem of the Tree-ferns of tropical and southern latitudes. Even in our British species, however, the corm or vegetative axis presents considerable diversity of form. The author has to regret that his opportunities of investigating the varieties of this organ have been so limited. He has been restricted, not only to our indigenous species, but, with few exceptions, to those growing in his own neighbourhood; for, though specimens of fern-fronds are readily enough to be had in exchange, few collectors preserve the rhizomes. From the examination, however, of such species as he has been able to procure, he believes that the corms of our British Ferns—if not of the tribe generally—may be reduced to the three forms of a stoloniferous rhizome, and a caudex, simple or branched.

* Communicated by the Author, having been read before the British Association, Sept. 15, 1859.

These varieties depend on the relations and proportionate development of the principal structural elements—the proper axis, the rootlets, and the fronds, whose bases remain permanently attached to the stem after the leaf-like portions have withered and decayed away. Organs corresponding to these enter into the constitution of all the higher plants. In the larger forms of vegetation, they are clearly marked off from each other by a wide local separation, the radical fibres coming off from one extremity of the stem, and the leaves from the other; but this arrangement is not an essential of the vegetable organization; for in various subterranean and creeping stems, such as those of the rose and the iris, the strawberry and many grasses, we have both rootlets and leafy shoots coming off side by side from a greater or less extent of the vegetative axis; and even where this assumes an arborescent character, such intermixture, though less frequent and less complete, is still an arrangement of occasional occurrence, as in the Banyan and other species of *Ficus*, *Pandanus*, *Dracæna*, &c. All these variations we have represented in Ferns. In Tree-ferns, as in arborescent forms of other types of vegetation, we have the length of the stem interposed between the rootlets and the bases of the fronds; and though generally, when the plant attains some height, adventitious roots are emitted from the sides of the stem, still they spring from its lower part, and are separated from the growing leaves by a very considerable interval. But in our indigenous species the stems are all more or less of the kind termed *rhizomes* by botanists, and emit rootlets and leaf-stalks side by side along their whole extent, or nearly so; and, as has just been remarked, it is to diversities in their disposition and proportionate development that the variations in the form of the stem are in great measure due.

In the first or stoloniferous variety, the axis is long, slender, and much branched, its subdivisions running horizontally along or just under the surface of the ground, and sending off from below numerous black wiry rootlets, and from the upper aspect the scattered petioles of the fronds. The extremities of the rhizome are scaly, the petioles smooth and naked. When a root of this kind is dissected out of the soil—an operation involving no small expenditure of time and trouble, from its tortuous and brittle character—we can readily distinguish the formations of successive years. At the growing points of the stolons we have the petioles quite fresh, and still bearing leaves; behind these, we have the bases of the last and former years' fronds in different stages of decay; and lastly, only the creeping stem itself, and this, as we trace it backwards, in a continually increasing state of decay, which finally makes it impossible to follow it any fur-

ther. By this disappearance of the common connecting portion of the rhizome, the later branches assume the position of independent plants, and the forest of fronds covering the turf may be compared to the vigorously vegetating leaf-shoots of a subterranean shrub whose trunks have already mouldered away.

Roots of this description occur in all our Polypodies (Pl. VIII. figs. 1, 2), in the Bracken, in *Hymenophyllum*, and probably also in *Adiantum*, *Trichomanes*, and in *Lastrea Thelypteris*.

The common Polypody, however, has one peculiarity, in which it stands alone among our indigenous Ferns,—that its petioles break off by articulations, so that the older portions of the stem do not bear the stumps of former leaf-stalks, but only cicatrices marking their insertions.

To this variety the form described as the simple caudex stands in the most marked contrast. Its characteristic features are the number and spiral arrangement of the petioles of the leaves. At its growing extremity these form one of the graceful circles of bright green foliage, which are so pleasing a feature in the vegetation of our larger Ferns. The axis itself is sometimes of considerable thickness, but its real dimensions are not distinguishable at first sight, from its being so completely ensheathed in the persistent bases of the decayed fronds of former years. Its direction of growth varies from horizontal to vertical (Pl. X. figs. 7, 8). In the former case, it creeps along or just under the surface of the ground, and forms a more or less considerable angle with the terminal crown of fronds, the axis of which is always vertical, owing to a corresponding curvature of the petioles at their points of origin. In cases, again, where the axis of the stem approaches the vertical, as in some foreign species of *Blechnum*, *Struthiopteris*, &c., it gradually rises above the ground in the course of growth, and assumes on a small scale the features of the arborescent form, the terminal circle of leaves corresponding with that elegant palm-like crown of foliage which is so prominent a characteristic of the Tree-ferns. The correspondence between such a caudex and the corm of a Tree-fern is brought out more clearly by cutting off all the bases of the old fronds at their points of insertion, when we obtain a nearly cylindrical stem, marked with rhomboidal scars, answering to those which, in most arborescent species, indicate the points of insertion of fallen petioles (Pl. X. fig. 9).

In this operation we have to clear away numerous radical fibres, as well as the petioles of old fronds, for the rootlets are equally abundant in this as in the former or stoloniferous variety, though, from the closeness of the leaf-stalks, between whose insertions they originate, they form but a secondary feature, except at the lower parts of the corm, where the decay of

the petioles allows them greater prominence. This form of stem would probably be better termed a right or straight than a simple caudex, for it generally bears *lateral* buds, giving rise to secondary rhizomes (Pl. X. fig. 10). Sometimes these appear to be deciduous, or to be pushed off by the growth of the petioles. In any case, they will of course become independent plants when the decay of the lower extremity of the caudex reaches their points of origin.

As examples of this form of caudex may be mentioned, *Lastrea Filix mas, L. dilatata, L. cristata, Polystichum aculeatum*, and *P. Lonchitis*.

The other form of caudex is intermediate between this last variety and the stoloniferous rhizome first described; for the axis branches so repeatedly in a dichotomous manner, by the duplication of its terminal buds, that, when dissected out, it has somewhat the character of the stoloniferous rhizome; but in its natural state it is so thickly set both with foot-stalks and rootlets, that nothing is to be distinguished but a mass of tangled roots, more or less tufted above and densely fibrous below.

A caudex of one kind or other occurs in all our larger Ferns except *Pteris aquilina*, and in the majority it appears to be branched. So at least it is in *Allosurus crispus, Blechnum boreale, Osmunda regalis, Lastrea Oreopteris*, and in *Filix fœmina* and the genus *Asplenium* generally. (Pl. VIII. fig. 3; IX. figs. 4, 5, 6.)

It is doubtful if the branched caudex ever becomes arborescent as a normal occurrence*. Branched Tree-ferns are certainly met with, but rather, it would seem, as an occasional abnormality than as a regular form.

Among our native Ferns, *Ophioglossum* and *Botrychium* are remarkable for their vernation being straight, not circinate, as in the rest of the group, and the last-mentioned species also for the edges of the solitary petiole cohering, so as to embrace the point of the axis and form a cavity which lodges the embryo of the next year's frond; within *its* petiole the rudiments of the frond of the succeeding year may in like manner be detected. The stem itself may probably be considered a modification of the simple caudex.

Among the Fern-allies of our flora, the stoloniferous is the most common form of stem. In Equisetaceæ it is subterranean, like that of the Ferns; but in *Pilularia* and *Lycopodium* it creeps along the surface of the ground. In the larger species

* An analogical argument in favour of this may be drawn from Palm-stems, which are normally simple from the development of a single terminal bud, but which are branched in a few species, as *Phœnix*, or form lateral buds, as in *Areca, Caryota*, and *Chamærops*.

of *Lycopodium* the successive stages of annual growth, and the separation of the shoots as independent plants by the gradual decay of the older portion of the stem, are more clearly brought out than even in the stoloniferous roots of Ferns. In *Isoëtes* we have a peculiarly modified form of the simple caudex.

Internal Structure of Fern-stems.

The next point to be noticed is the internal structure of the vegetative axis of the Fern, principally as it affects the disposition of the fibro-vascular bundles. Woody fibre and vessels (which, except in a few degraded species, are a universal characteristic of phanerogamic plants) occur, it is well known, only in the higher forms of cryptogamic vegetation—the Ferns and allied orders,—and even there but sparingly and with some remarkable peculiarities both in their minute structure and their general disposition. The most observable structural characters are the dark colour of the woody or hard tissue, and the large size, angular section, and scalariform markings on the ducts. In the disposition, too, of the fibro-vascular tissue, the stems of Ferns present some remarkable peculiarities, quite as distinct as those characteristic of the better-known divisions of the so-called Endogenous and Exogenous stems. These differences do not so much affect the original constitution of the stem as the mode in which the successive annual increments are applied to the primary axis. In vascular shoots of the first year, whether Dicotyledonous, Monocotyledonous, or Cryptogamic, there is comparatively little difference. In each we have a single circle of fibro-vascular bundles imbedded in the general cellular tissue of the stem; but when the new bundles of subsequent years come to be added, we find the characteristic differences clearly brought out. Thus the peculiarities of the Exogenous stem depend on the addition to the exterior of the wood and interior of the liber of former years, of annual layers, forming in section concentric circles of ligneous and cortical tissue. Hence the accretions to the wood of a Dicotyledonous stem have been represented by a number of cones of continually increasing dimensions placed one over the other, and slightly truncated at the top. In horizontal sections the wood of such a stem presents a series of concentric rings, which represent the bases of the cones, interrupted by radiating bands of muriform tissue, which are the outward continuations of the cellular interspaces between the bundles of the original circle, and represent the small residue of the cellular element of the stem left after the abundant development of fibro-vascular tissue characteristic of the Dicotyledonous organization. In a tangental section, these same bands are seen cut across, and may be observed to occupy the meshes left

by the interlacement of the longitudinal fibro-vascular bundles. Though the formation of wood in Dicotyledonous plants is spoken of as being on the exterior, and has hence given rise to the stem being termed Exogenous, still it is to be remembered that at the growing points the fasciculi do in fact pass from the petioles of the leaves into the interior of the stem, and only gain that position which characterizes the rest of their course by curving outwards again to apply themselves to the exterior of those of older formation.

In the Monocotyledonous stem, again, the fibro-vascular fasciculi, though they tend at last in the same way to place themselves on the outside of those of older development, lose themselves here, by the dispersion and occasional anastomosis of their elements, in what has been termed the fibrous layer of the stem, and do not descend any way on the exterior, or form any new continuous envelope like an annual layer of Exogenous wood. Hence, should we wish to represent the increments of a Monocotyledonous stem by a series of superposed truncated cones, we must make them, not, as in Dicotyledons, of continually increasing dimensions, so that the outer shall completely envelope the inner, but we must make them all of the same size, so that the series as a whole may have, not a conical but a cylindrical outline, the outer cones being borne up by those within and below them, whose bases they can no longer cover. They are also more truncated or more open at the top, from the larger size of the cellular core of the terminal bud. Such a stem, on horizontal section, is described as presenting three regions:—1st. A central, which in some respects corresponds to the pith of a Dicotyledon, but which contains imbedded in the cellular tissue the ends of numerous fibro-vascular bundles, divided in their descending but at the same time outward-bound course through the interior of the stem. 2ndly. A cortical zone, also of cellular tissue, differing from the bark of a Dicotyledon in not being generally separable from the stem, and in rarely containing any fibrous tissue. 3rdly. Intermediate between the central and cortical regions, a ring of densely-matted fibrous tissue, formed by the anastomosis of the lower and outer ends of the fibro-vascular bundles.

In the stems of Ferns, the fibro-vascular element is but very sparingly developed in proportion to the cellular, and the disposition of the fasciculi assumes in consequence a different appearance from that in either of the higher groups; the vascular bundles are well developed in the petioles of the fronds, but they enter no further into the structure of the stem than simlpy to effect a union with those derived from the fronds of former years. They have no downward course in the stem; the

arched fibres in the interior, characteristic of the Endogenous stem, and the annual layers of descending woody tissue on the exterior (so conspicuous a feature in that of Exogens), are alike wanting; for the fasciculi, immediately on entering the stem, branch out and anastomose with those derived from former petioles, forming a very beautiful reticulated cylinder near the exterior, analogous evidently to the "fibrous layer" of the Monocotyledonous stem, but presenting, instead of the dense fibrous interlacement of the latter, a network of thick cords of scalariform tissue, ensheathed in a layer of brownish pleurenchyma, and separated by large open meshes, through which the cellular tissues of the central and cortical regions are freely continuous with each other (Pl. X. fig. 11). The pile of superposed truncated cones, diagrammatically representing the Exogenous stem—already cut down all to one length, and more opened at the top to adapt them to the Endogenous type—must now be reduced to a series of simple rings placed one upon another.

On a longitudinal section along the axis, a fern-stem presents a uniform expanse of cellular tissue, marked only by an interrupted line near each margin, indicating the position of the fibro-vascular bundles of the reticulated cylinder, the interrupted spaces answering to the meshes of the network (fig. 10). On a horizontal section we have a corresponding interrupted circle formed by the cut extremities of the fibro-vascular anastomosing cords (fig. 12). This circle divides the section into a large central and a smaller cortical region, both composed of cellular tissue, as in the Monocotyledonous stem, but without the descending fibres which form so conspicuous a feature in the interior of the latter. In a certain point of view, these regions correspond to the pith and cellular bark of a young Dicotyledonous stem, in which the cellular tissue has not yet been displaced by the fibro-vascular element; and the interspaces of the reticulations may be held to represent the medullary rays. Indeed, in all the fibrous tissues of Dicotyledonous plants a tendency may be observed to such an interlacement about the medullary rays: it is quite obvious to the naked eye in the bast-fibres of the Lime and many other trees; it has been noticed in the medullary sheath of Coniferæ, and it may be seen with great distinctness under the microscope, in tangental sections of mahogany and other hard woods.

The stems of Tree-ferns are said to be generally hollow, but the character is not an essential one. Fistulous stems are well known to occur both in Endogenous and Exogenous plants*, and

* In Endogens, the Cocoa-nut and other Palms and most grasses, in Exogens, many Umbelliferæ, Compositæ, and Labiatæ furnish instances of this.

probably always depend on the shrinking of a lax cellular tissue originally filling the space. Hollow stems are not described as occurring in any of our indigenous Ferns, but it may generally be observed that in the decayed portions of a rhizome the central cellular tissue is the first to disappear.

The most elegant and instructive preparation of a fern-stem is made by dissecting off the outer cortical layer so as to expose the reticulated structure of the fibro-vascular cylinder. Two sets of fasciculi will then be seen to be connected with its exterior, —the one derived, as already noticed, from the bases of the petioles, the other continuous with the rootlets.

The rootlets of Ferns are emitted in succession from below upwards, in proportion as they are required for the nutriment and mechanical support of the plant. The latter is probably the main use of the so-called adventitious roots, which are sent forth in such numbers from the lower part of the stem in some Tree-ferns as to cause a remarkable increase in the diameter of the base. The nutriment introduced by the roots must be carried up by imbibition through the cellular matter of the stem, or through the fibro-vascular network derived from the bases of petioles long since decayed. In any case, it is evident that, whatever may be alleged in favour of regarding a Dicotyledonous tree as a mere aggregation of slender stem-bound phytons, whose leaf-bearing shoots form its present foliage, while their downward extremities are continuous with the active spongioles of the roots, such a view cannot be held tenable in the case of Ferns. In this group at least, and probably also in Monocotyledons, we must admit two fundamentally distinct foci of vital action—the leaf-bud and the rootlet,—the former originating from the upper extremity of the stem, the latter connecting itself with its lower portions. In neither of these forms of vegetation can the rootlets be regarded (as some would regard them in Dicotyledons) merely as the onward continuation of fasciculi sent down from the leaves, for the bundles of the leaf-stalks descend, in Monocotyledonous plants, but a small way along the stem, and in Ferns not at all; while, in arborescent species, the radicles are emitted only from the inferior parts, far below the point reached by the former.

There is every reason to believe that the emission of the rootlets is a purely local action, and Prof. Henfrey's description of it in Monocotyledons seems to apply also in Ferns*. According to this author, the first rudiment of the rootlet is a funnel-shaped circle of fasciculi in the cortical region at the base of the stem, which, on the one hand, implant themselves upon the fibrous layer within, and, on the other, converge to form the

* Ann. Nat. Hist. i. 187.

central axis of the rootlet, and force their way outwards through the tissue of the cortical zone in which they were developed. Without venturing to say how far this local formation of rootlets may occur also in Dicotyledons, it may be remarked that in all forms of radical fibres the vascular bundles have an arrangement different from that in the stem, and such as would follow from this mode of formation,—the fasciculi lying in the axis of the rootlet, to the exclusion of the pith or cellular core which occupies the central region in all the upward shoots. It may be observed also, that, even in Dicotyledons, a certain vegetative independence is indicated in the origin of rootlets, from the local application of moisture so fostering their production as to cause their development even from abnormal parts.

It does not appear that the assumption of two distinct developments of vegetative power in the guise of leaf-buds and rootlets—or, as they might be termed, *phyllophytons* and *rhizophytons*,—is at all opposed to the analogy of other forms of organization; for we observe a corresponding diversity of individualized organs in various compound animals, as, for instance, in the alimentary, generative, and protective appendages of Hydractinia, the polypes and avicularia of the Polyzoa, and the cirrhi and ovarian capsules of the Physograda,—parts which may certainly be *assumed* to be mere modifications of a common original form, but between which it would not be easy to point out much community of structure in proof of such co-relative derivation.

There still remains for consideration the arrangement of the dark-coloured tracts commonly regarded as of the nature of woody tissue; but for the present it may suffice to notice the great diversity which prevails in different species in the disposition of these fasciculi. Thus, in *Osmunda* we have an accumulation of dark tissue on the exterior of the caudex; in *Blechnum boreale*, again, it occupies the interior; in *Pteris aquilina* it forms broad bands interposed between an outer and inner layer of vascular tissue; while in *Filix mas* it exists only as a thin stratum ensheathing the latter; in *Lastræa dilatata* it occurs in isolated masses in the cellular core of the rhizome.

The author may remark, in conclusion, that but a few days ago his attention was called by a friend to an incidental notice —the only one he has yet met with—of the fibro-vascular system of Ferns, in a paper on Sigillaria in the 'Edinburgh Philosophical Journal' for 1844, by Mr. King of Newcastle, which, from its geological title, he had previously overlooked. Mr. King's remarks, so far as they go, will be found quite in accordance with the foregoing. He surmises that in Tree-ferns (owing to the greater development of the longitudinal fasciculi) the regular rhomboidal meshes may be reduced to long narrow slits. This

is the more probable from an arrangement precisely of this kind obtaining in creeping rhizomes, such as those of the bracken. It is well known to botanists that there is a similar diversity in the extension of the medullary rays of Exogens: they are much larger, for instance, in the oak than in most other woods, and in the *Clematis* they reach the whole length of the internodes, so that, when they decay, the stem breaks up by the separation of its component woody wedges.

EXPLANATION OF PLATES.

Plate VIII.

Fig. 1. A portion of the branched and creeping rhizome of *Polypodium Phegopteris*, showing the fringe of wiry rootlets and the persistent bases of old leaf-stalks.

Fig. 2. The branched and creeping rhizome of *Polypodium vulgare.* It is more thickly set with rootlets than the last, and marked with the scars of fallen petioles.

Fig. 3. The dichotomous caudex of *Blechnum boreale*, with the axis exposed by cutting off, close to their origin, all the foot-stalks of former years' fronds.

Plate IX.

Fig. 4. The dichotomous caudex of a large bushy specimen of *Allosurus crispus*, stripped of the rootlets, the petioles of former years, and of most of the fronds.

Fig. 5. The dichotomous caudex of *Asplenium Filix fœmina*, exposed by a section along the axis of its several branches, to show the connexion of the bases of the leaf-stalks of successive years with the core of the stem.

Fig. 6. Another specimen of the same species, with the caudex stripped of its rootlets and petioles, the scars with which it is marked indicating their points of attachment. Of these there must be considerably more than a thousand: the plant had certainly upwards of a hundred fresh fronds when dug up.

Plate X.

[Illustrations of the rhizome of *Lastrea Filix mas.*]

Fig. 7. A caudex which has been forced into an upright line of growth.

Fig. 8. Another specimen, showing the usual horizontal direction of growth, the terminal bud forming an angle with the rhizome.
Both these specimens are in their natural state.

Fig. 9. Tessellated appearance of the surface of the caudex when the petioles are cut off close to their origin. The dots indicate the cut ends of the vascular bundles going to the fronds.

Fig. 10. Perpendicular section of an upright caudex, showing the interrupted line on each side of the axis, where the reticulated fibro-vascular cylinder has been divided by the section. The figure shows also the connexion of the bases of the petioles, and a lateral bud arising from one of them.

Fig. 11. A portion of a preparation showing the netted fibro-vascular cylinder of the caudex, removed entire by careful dissection from

the cellular matrix. The further side of the cylinder is imperfectly shown, from having been out of focus in the photograph. The secondary fasciculi, proceeding to the leaf-stalks and rootlets, give the exterior a bristly appearance.

Fig. 12. A diagrammatic transverse section of the caudex. The interrupted circle represents the cut extremities of the fasciculi of the netted cylinder, and the scattered dots on its exterior those of the secondary fibro-vascular bundles of the petioles and rootlets.

[The above figures are mostly from photographs of the original specimens (now in the Museum of the Royal Botanic Garden, Edinburgh) by Mr. Andrew Adams of Aberdeen.]

XLI.—*On the Reproduction of the Bark-Lice* (Chermes, &c.); *a further Contribution to the Knowledge of Parthenogenesis.* By Rudolph Leuckart.

[Concluded from p. 327.]

Before tracing these differences and analogies further, it is necessary, however, that we should glance at the *anatomical arrangement of the generative apparatus* in our Bark-lice (Pl. VII. fig. 1).

In the four or five species (three or, if *C. Abietis* is to be regarded as two species, four *Chermes*, one *Phylloxera*) there is a perfectly unmistakeable analogy in the formation of the female parts; and this is the more striking, as it at the same time furnishes a perceptible distinction from the female organs of the true Aphides*, which propagate both by oviparous and viviparous generations. On the whole, however, the type of the organs in question is the same as that we meet with in the latter.

With regard to the ovaries, it must first be indicated that the egg-tubes of our animals are in all cases composed of two, or even three (*Phylloxera*) chambers (fig. 1). From the previous statements with regard to the structure of the egg-tubes in the ordinary Aphides, we might suppose that this is the expression of a thorough-going distinction between these two groups; but I have ascertained by my investigations of this year, that among the Aphides there are species with plurilocular egg-tubes, although the greater number of them certainly have only one chamber, like the *Coccina*. Among these species with pluri-

* As far as we know, *Chermes* and *Phylloxera* are the only Aphides with solely oviparous generations. That there are also species with only viviparous generations, as stated by Kaltenbach, appears to me very doubtful. In *Schizoneura*, which is said amongst others to be in this case, I have proved the existence of an oviparous autumnal generation in the small memoir already repeatedly mentioned.

locular egg-tubes are *Aphis Quercus* and *A. platanoïdes**, the wingless females of which exhibit three (and *A. platanoïdes* even four) deposits, representing eggs, in the individual egg-tubes. (Dr. Claus of Marburg has also met with wingless females with plurilocular egg-tubes, in two apparently unnamed species of *Aphis* from *Betula alba.*)

If this latter observation were not sufficient of itself to efface the distinction which apparently prevails, with regard to the formation of the egg-tubes, between our Bark-lice and the other true Aphides, I must further indicate that the second, superior germ in *Chermes* (especially in *Chermes Laricis*, fig. 1) is not unfrequently formed only at a later time, or not until the preceding egg approaches its perfect maturity; that therefore, under such circumstances, the same egg-tube may consist sometimes of one and sometimes of more chambers, according to the age and state of development of its contents†. Moreover the eggs in the different tubes arrive at maturity at different times, so that tubes of one and two chambers may not unfrequently be met with together in the same ovary. In the same way, at certain times, the tubes of *Phylloxera* consist only of two chambers‡, those of *Aphis platanoïdes* of three, &c.

Although, therefore, the distinction between the unilocular and plurilocular egg-tubes does not appear to be very great, still, on the other hand, it is not to be altogether disregarded. This is most distinctly evidenced in the different destiny of the superior clavately-inflated extremity of the egg-tube, which, with its peculiar cellular corpuscles, has sometimes been regarded as a proper superior chamber. In the Plant-lice with unilocular egg-tubes this terminal piece, with its contents, is gradually lost during the evolution of the egg-germs; in the species with plurilocular egg-tubes it remains unchanged, just as it was with the first egg-germ, without ever diminishing perceptibly in size or becoming aborted.

* Dr. Claus called my attention to the fact that the nurses of this species are not unfrequently attached after death to the surface of the leaves inhabited by them, by means of a rather large convex disc. On closer examination I recognized in this disc the cocoon of a larva which, from its appearance, would probably be that of an Ichneumonidous insect. This larva lives, up to the time of its change to the pupa state (and indeed always singly), as a parasite in the Aphides, but afterwards breaks through at the ventral surface, and then spins its cocoon between its previous host and the surface of the leaf.

† This is also in accordance with the fact that the egg-tubes of our species of *Chermes* (*C. Abietis*) are at first developed as simple tubes, exactly in the same way that I have described for the egg-tubes of *Aphis* and *Coccus*.

‡ Individual egg-tubes of *C. Abietis* also now and then exhibit a third egg-rudiment.

In the small treatise on Parthenogenesis already repeatedly cited, I have referred to this superior portion of the unilocular egg-tubes in the Aphides as the "vitelligene;" and indeed its resemblance to the vitelligenes of the plurilocular egg-tubes described by Stein is unmistakeable. Supposing this interpretation to be correct, all analogy would lead us to expect that a vitelligene of this nature would be repeated between each two egg-germs in the plurilocular egg-tubes of our plant-lice. But this is not the case. The Aphides with plurilocular egg-tubes also possess only a single vitelligene, and this only at the upper end of the egg-tubes (fig. 1).

This circumstance must render it doubtful, notwithstanding any similarity, whether it be correct to regard the terminal piece in question as a "vitelligene." We might now suppose, with apparently greater justice than previously, that the structure in question is a so-called germigene, and regard the individual cellular corpuscles in its interior as egg-germs; and this perhaps might be done the more readily, as the compartment in question resembles, in the formation and appearance of its contents, the terminal piece of the so-called germ-stock in the viviparous Aphides, the individual cellular corpuscles of which, according to Leydig, become converted directly into the future germs. In this way, therefore, we may establish an analogy between the genitalia of the viviparous and oviparous Aphides, which may also perhaps, in another respect, serve as a guide for the comprehension of the entire mutual relation of these two forms of individuals.

I admit that I do not regard this question as yet ripe for decision. It is certain that, from our present observations, the consideration of this terminal piece as a germigene is somewhat seductive; but the aspect and nature of the cellular corpuscles in its interior are different from those ordinarily met with elsewhere in the germigenes of insects; and, moreover, I have never yet succeeded (nor, indeed, with the viviparous Aphides) in convincing myself by direct observation of the conversion of these cells into egg-germs. On the contrary, we may detect certain differences in size, behaviour towards reagents, &c., between the germinal vesicles of the youngest ova and the nuclei of these cellular corpuscles (which, nevertheless, must be identical if the latter are to be regarded as egg-germs), such as are scarcely in favour of any such assumption. Thus, for example, in *Lecanium Hesperidum* I found the germinal vesicles of the youngest ova 0·02 millim. in diameter, whilst the nuclei of the cellular corpuscles in the terminal compartment measured 0·037 millim. In *Coccus Hesperidum* the germinal vesicle, at a still earlier grade of development, was 0·009 millim., also smaller than the nuclei,

which measured 0·018 millim. The same thing applies to the Aphides. To this we must add the fate of these cellular corpuscles in the unilocular egg-tubes of the Aphides and *Coccina*, which is also scarcely in favour of the opinion that they are converted into egg-germs, although indeed cases of abortive egg-germs are not very rare.

On the other hand, the interpretation of the compartment in question as a "vitelligene" appears by no means to be contradicted by its simplicity in the plurilocular egg-tubes of our Aphides. We certainly must not assume, as Stein does, that in the case in question the granular yelk is *exclusively* furnished by the cells of the vitelligene. This one-sided interpretation may probably find but few supporters at the present day. I think we have arrived pretty generally at the opinion that, besides the cellular corpuscles of the vitelligene, the ordinary epithelial cells of the egg-tubes also take part in the deposition of the yelk. This part is indeed probably only a subordinate one; but in our Aphides it may suffice for the completion of the maturity of the egg, the rather as the contact with the terminal compartment is not interrupted until a somewhat late period—indeed not until the yelk has already grown to a very considerable mass.

With regard to the histological structure of the egg-tubes, there is nothing particular to mention, unless it be the circumstance that our Bark-lice closely resemble the other Aphides in the great number of the cellular corpuscles occurring in the terminal compartment. Between these and the structureless proper membrane we not unfrequently see a delicate epithelial layer, which, however, also occurs in the same place in the allied animals, and does not appear to be by any means deficient even in the viviparous Aphides. The process of egg-formation is exactly the same as described by me in *Aphis* and *Coccus*. Even the short and solid peduncles adhering to the inferior pole of the egg-shells in *Chermes* constitute no characteristic distinction of our animals, since I have found the same structure on the eggs of *Aphis Quercus* and *A. platanoïdes**.

With regard to the number of egg-tubes in the ovaries of our Bark-lice, we find very considerable discrepancies, not only in different species, but also in the different winged and wingless individuals of the same species. In the latter respect it prevails as a law—if we may judge from *C. Abietis* and *C. Laricis*—that the winged individuals, as they are on the whole of a more slender structure, also possess a smaller number of egg-tubes†.

* It may be mentioned here, in passing, that the small winged males of *A. platanoides* possess three perfectly separated, pyriform testicular tubes on each side.

† This also appears to apply to the winged and wingless viviparous

The greatest number of egg-tubes occurs in the wingless females of *Chermes Abietis*, which is also by far the most prolific of all Bark-lice. In this species I have counted 20–24 egg-tubes on each side—a number which almost reminds one of the structure of the ovary in the *Coccina**, to which our plump animals (like the rest of the wingless Bark-lice) also bear an external resemblance. In the winged individuals the number of egg-tubes varies between far greater extremes: I have met with individuals with 24 and 30 egg-tubes in all, and with others which had only 10. The latter specimens were at the same time much smaller than the others; they are Ratzeburg's so-called males. In the number of egg-tubes, *Chermes Abietis* is approached most closely by the genus *Phylloxera*, the wingless females of which usually exhibit five egg-tubes on each side. *Chermes Piceæ*, in the wingless state, possesses three or four egg-tubes on each side (sometimes also nine in all). The number is lowest in *C. Laricis*, the wingless individuals of which very constantly possess six egg-tubes, whilst the winged examples (fig. 1) usually present only four (but sometimes five) in all.

The oviducts to which the egg-tubes are attached are, as in the Aphides, of but inconsiderable length, and have a distinct muscular layer, with fibres which principally run in a transverse direction and are repeatedly branched. A very similar but still more strongly developed muscularity is also possessed by the single oviduct.

In the oviparous Aphides and the *Coccina* there are, as is well known, two different kinds of accessory structures on this oviduct,—a pair of sac-like or tubular organs with fatty contents, which we shall indicate as a lubricating gland (*Schmierdrüse*), and at a greater or less distance above these, a roundish or pyriform pouch, the *receptaculum seminis*. The case is very different in our Bark-lice (fig. 1). On a superficial examination we find only two accessory organs, which are attached at about the limit of the posterior third of the oviduct, and show themselves to be the lubricating gland, notwithstanding several peculiarities, both by their structure and the nature of their contents. Above this gland we may seek in vain for another appendage; but, on the other hand, far below, immediately over the obtuse

individuals amongst the Aphides; at least, I have hitherto met with the unilocular germ-tubes first described by me only in winged individuals of these animals. Nevertheless, it can by no means be said that all winged Aphis-nurses possess unilocular germ-tubes. I also know species the winged nurses of which are provided with plurilocular and multilocular germ-tubes.

* In the true Aphides I have never met with more than four egg-tubes on each side.

and conical ovipositor (undoubtedly the same structure that Ratzeburg indicated as the penis, but which occurs in exactly the same way in all individuals), we see a very inconsiderable pedunculated pouch appended to the sexual passage. The stalk of this organ is lined with a tolerably strong chitinous plate; but this covering gradually disappears towards the upper part, and at last vanishes so completely that it requires great attention, and particularly favourable preparation, to enable us to make sure of the existence of a cavity in the interior. The wall of the pouch consists of delicate, clear, vesicular cells.

It would, of course, be most interesting to ascertain the physiological signification of this organ, as by this means the question would be decided whether these Bark-lice are or are not furnished with a *receptaculum seminis.* For this purpose, unfortunately, I possess no data. I have never observed any peculiar contents in the vesicle in question, nor have I ever discovered it in other Aphides. If, under such circumstances, we may suppose it possible that this represents a seminal receptacle, on the other hand, its position and appearance are so little in favour of this supposition that I am far more inclined to assert that there is an entire absence of a seminal receptacle in our Bark-lice. We are acquainted with many insects in which the secretory appendages on the oviducts are increased (even in the *Cicadæ,* which are allied to the Aphides, we meet with many such structures); it is therefore possible that the Bark-lice may be amongst this number.

The lubricating glands which, in the Aphides, usually appear as roundish pouches, and rarely (e. g. *A. platanoïdes*) as long and wide tubes, likewise differ in their organization in the Bark-lice. *Phylloxera* possesses on each side (fig. 4) a cylindrical appendage repeatedly notched, the short and stump-like branches of which all lie in the same plane. The cellular walls are of considerable thickness, and enclose a thin chitinous tube, which, at its lower end, close to its insertion into the oviduct, becomes dilated into a flask-shaped cavity. The contents of these tubes consist of the same yellowish oil which is elsewhere met with in the lubricating glands. It may be expelled by pressure from the tube into the flask-shaped cavity, which is also usually filled with it, and thence into the oviduct. At the point where the two accessory glands open into the oviduct, the latter is of considerable width. At the same place there is, in the interior of the oviduct, a peculiar loop-like structure, which, on closer examination, proves to be a narrow, much-curled, chitinous band, clothing the oviduct in an annular form exactly at the level of the accessory glands, and amalgamating on each side with the chitinous wall of the flask-shaped oil-vesicle. This band does not, however, lie

loose in the oviduct; it is rather only an annular thickening in the delicate chitinous coat which lines the entire oviduct.

In *Chermes* (figs. 1–3) there is the same chitinous band as in *Phylloxera*, and also an evident, though less distinctly separated, funnel-shaped or pouch-like oil-vesicle; but the gland is very strikingly different. It appears on each side as a flattened ear-like appendage of an oval form, with a space of a similar shape in its interior, and a delicate, strongly granulated, chitinous lining. The exterior surface of this chitinous wall is drawn into numerous folds, which are continued between the neighbouring cells of the gland, and are gradually lost. At the point of insertion of the glands, the oviduct (fig. 2) forms an inflation of considerable size but with little muscularity, which is constricted in the middle by the elastic contraction of the chitinous band. As soon as an egg passes this spot, this constriction is effaced, whilst the chitinous band at the same time gradually expands (fig. 3) and acquires a rather smooth appearance. I will not here dwell further upon the mechanical importance of this arrangement, hitherto discovered only in the Bark-lice; it is, however, evident that in it the elasticity of the chitinous band is of the highest importance.

To the preceding account of the structure of the generative organs in the Bark-lice, and their remarkable mode of reproduction, I shall take the liberty of adding a few further observations.

The first relates to *the occurrence of the two different forms* indicated by us amongst the parthenogenetic females of these animals.

We have characterized these two forms as wingless and winged. It must not, however, on this account be supposed that their distinctions are limited to the presence or absence of organs of flight, and that the differences here occurring may be compared to those which we meet with as regards the formation of the wings in many species of Orthoptera (see Fischer, Entomol. Zeitung, 1852, p. 15) and Hemiptera. The distinctions of these two forms are far more considerable; they extend to the entire external organization of the individuals in question, to their size, form, and the structure of the segments of the body, and affect even the internal structure in a remarkable manner. Without a knowledge of their genetic relations, the two forms would necessarily be regarded not merely as representatives of different species, but even of different genera. The difference is scarcely less than that in the sexes of the *Coccina*. In other words, it is a complete dimorphism that we here meet with.

That these distinctions are also expressed in the mode of life is no more than might have been expected; and indeed, on the

most superficial examination, the part which the two kinds of individuals have to play in the history of our Bark-lice is seen to be distinct. The wingless females serve especially for the maintenance, the winged ones, on the contrary, principally for the diffusion of the species. The former are highly fertile for a long time, but at the same time (probably in intimate connexion with this property—see Leuckart, art "Zeugung," in Wagner's 'Handwörterbuch,' iv. p. 719) scarcely in a condition to quit their dwelling-place. The existence of the species would perhaps be endangered in many ways, if the timely appearance of winged females did not furnish the means of finding new dwelling-places and sources of nourishment. But with the transfer of the ova the task of these winged females is fulfilled. After depositing the eggs, a few days after their birth, they perish.

A very similar dimorphism also occurs, as is well known, in the so-called *nurses* of the ordinary Plant-lice, which in the first generations are likewise wingless, but in the later ones are almost always furnished with wings.

These are circumstances to which very little attention has hitherto been paid. We usually speak merely of the difference of two sexes, and tacitly suppose a complete agreement between all the individuals of these sexes. With such a notion, it certainly appears highly anomalous when, in the communities of the social insects, we suddenly meet, besides the unmistakeable males and females, with other forms of individuals, and recognize these as a peculiar, remarkable modification of these sexual animals. The Plant-lice show us that a similar polymorphism also occurs elsewhere among Insects, and that especially the female individuals of these animals very frequently differ from each other even by peculiarities of their structure, according to the difference of their appointed tasks.

A second observation refers to *the relation of the Parthenogenesis occurring in these Bark-lice (and in certain* Coccina) *to the so-called alternation of generations in the Aphides.*

That these two modes of reproduction are in many respects allied and similar has already been pointed out by me in another place ('Generationswechsel und Parthenogenese,' p. 44). Not long ago, indeed, it was thought right to speak of an infinite difference between the Aphis-nurses and females; but such a notion now appears erroneous. Our object is rather to test the extent and value of these analogies—to ascertain especially whether the constantly-reviving assertion recently supported by Claus (Generationswechsel und Parthenogenese im Thierreiche, 1858, p. 22), that the so-called nurses of the Aphides are essentially nothing but parthenogenetic females, is correct.

The decision of this question is intimately connected with our opinion as to the nature of the reproduction occurring in the so-called nurses; it depends upon whether we regard this as an asexual reproduction or not.

The preliminary question that naturally first presents itself here is, where are we to seek in general for the distinguishing characteristics of sexual and asexual reproduction. If we indicate that reproduction alone as sexual in which a cooperation of two kinds of reproductive matter (in other words, a fecundation) takes place, there remains, of course, no ground for bringing the alternation of generations in the Aphides into the question at all. But then, to be consistent, we must refer Parthenogenesis to asexual propagation, as indeed is done by Radlkofer ('Ueber das Verhältniss der Parthenogenesis zu den anderen Fortpflanzungsarten,' 1858). Whether this view will some day find general acceptance, I do not know; but to me it appears to be rather bold to regard the same substratum, an egg, sometimes as a sexual, and sometimes, just according to circumstances, as an asexual reproductive material*. In my opinion, it is always the same—always the product of the same (sexual) activity, whether the cycle of conditions under which it is developed into a new creature be closed by the access of semen, or without this. Wherever we have to do with an egg, there also, in my opinion, sexual reproduction always takes place.

It appears to me, therefore, that it is less the occurrence of a fecundation than the nature of the developing substratum that must guide us in the assumption of a sexual or asexual propagation.

In the case now especially before us, there would also be the question whether the germ-corpuscles of the viviparous Aphides can be regarded as eggs.

That these germ-corpuscles are cells like the eggs, and indeed cells which become converted into the embryo in a manner analogous to that of the eggs, can no more be doubted, after the recent investigations, than the morphological relations of the germ-tubes and ovaries in which the reproductive matters in question originate. It is even possible that future investigations may demonstrate an essential accordance in the mode of production of these two kinds of structures. All this must incline us, to a certain extent, to regard the germ-cells and ova of the Aphides as morphologically identical structures.

* The criterion of sexual and asexual reproduction put forward by Radlkofer, namely the idiotypic or zelotypic nature of the product, cannot suffice here (as indeed in other cases in the alternation of generations with larval nurses); for the product of parthenogenesis furnishes, *e.g.* in *Chermes Abietis*, not (zelotypic) copies of the parents, but individuals of a different and independent original development (idiotypes).

On the other hand, however, it cannot be denied that many considerations come in the way of the assumption that the two kinds of reproductive bodies occurring in the Aphides are both of the nature of ova.

I will not dwell too much upon the fact that, according to this supposition, the Aphides would produce two kinds of eggs. We are acquainted with similar facts in other animals, especially the *Daphniæ* and Rotifera*, the reproduction of which might also be adduced in favour of this view, inasmuch as, according to the investigations of Lubbock (Phil. Trans. 1857, i. p. 98) and Cohn (Zeitschrift für Wiss. Zool. 1858, p. 284), the animals in question also possess the faculty of Parthenogenesis. It is true that the two kinds of eggs of the above-mentioned animals are by no means so strikingly different as the eggs and germ-cells of the Aphides; but we must also admit that the peculiarities of the latter (judging from my observations upon the ova of the Cestoid worms and their development) by no means overstep the bounds of the empirically established limits of egg-formation, remarkably as these peculiarities, on the other hand, approach to the nature and destiny of unmistakeable germ-cells. (Generationswechsel und Parthenogenese bei den Insekten, p. 20.)

It appears to me to be of far more importance, that the germ-granules of the Aphides are evidently not calculated for any fecundation. I have taken a previous opportunity of pointing out this distinction (Generationswechsel und Parthenogenese, p. 110). At that time it appeared to me sufficiently great, notwithstanding any similarity to Parthenogenesis, to cause me to regard the reproduction of the Aphides as an alternation of generations. An egg which excludes all fecundation still appears to me to be a somewhat problematical structure; but this furnishes no sufficient reason for denying the possibility of such eggs. Claus here refers to the eggs of the worker bees, which would also never be fecundated, and we might cite other cases, and especially our Bark-lice, in which even the organization of the sexual passages, in the same way as in the viviparous Aphides, appears to betray the absence of a sexual intercourse. But all these cases only present limited analogies, inasmuch as the obstacles to fecundation in them (as, indeed, Claus admits) consist only in external, more or less accidental conditions, and are by no means caused, as in the Aphides, by the nature of the germinal product.

* The Freshwater Bryozoa can scarcely be adduced here, as, according to Allman (Monogr. of the Freshwater Polyzoa, p. 37), the so-called winter-eggs of these animals are not eggs at all, but structures of very different organization and development, which the author regards as asexual reproductive bodies (statoblasts).

A second circumstance, of great importance in the inquiry into the nature of the reproduction of the Aphides, is that the germ-granules of these animals are only developed in certain individuals, whilst other individuals, making their appearance under particular circumstances, lay unmistakeable eggs, and fertilize these in the usual manner.

From the point of view of the alternation of generations, such a regular alternation of fertilized and unfecundated individuals appears quite natural, and even necessary; but in the domains of Parthenogenesis, as far as our present knowledge goes, we seek in vain for an analogous case. Although in the Bark-lice, in *Lecanium Hesperidum, Solenobia lichenella,* and other animals which usually propagate exclusively by Parthenogenesis, a fecundation (by the males, which are still entirely unknown to us) may perhaps take place from time to time, there is still not the least ground for assuming a regular, and, under certain circumstances, necessary repetition of this process. In all these cases we must take the possibility of a fecundation into consideration for every distinct individual; a fecundation which takes place only occasionally, and then necessarily, in particular individuals, but is and must be just as regularly dispensed with in the intervals, has been recognized at present only amongst animals which are developed in accordance with the alternation of generations.

If, in spite of all these considerations, the reproduction of the Aphides is to be ranged under Parthenogenesis*, we are compelled, as, indeed, Claus very justly felt, to establish a peculiar form for it. This would then stand in precisely the same relation to the ordinary Parthenogenesis, in which each individual produces eggs capable of spontaneous development, as the alternation of generations to ordinary asexual reproduction, which, as is well known, in the animals with an alternation of generations, is likewise transferred only to particular individuals, peculiarly organized for the purpose.

The Parthenogenesis of the Aphides would thus still remain to a certain extent allied to the alternation of generations, even if it did not positively coincide therewith.

We must leave it to future observers to decide positively as to the justice of one or other of these views. Our observations upon Parthenogenesis are still so recent, and the possibilities of the differences and combinations occurring here so little known and weighed, that it appears scarcely possible at present to formulize

* It may be mentioned here, in passing, that, from analogy with the Aphides, the propagation of *Gyrodactylus elegans* must also be regarded as Parthenogenesis. Here also there is the same analogy between the nurses and sexual animals, the brood-stock and germ-stock, the germ-cell and the egg (germinal vesicle).

in either direction. We also still want many important data, necessary, and perhaps decisive, in the estimation of the conditions now under consideration. Under such circumstances we cannot emphatically enough recommend the continued careful study of the Aphides. We must still admit the truth of the concluding sentence appended by the acute De Geer to his memoirs upon the Aphides:—"The Aphides are insects which are in a position to overthrow the entire supposed system of generation, and to confuse those who attempt to investigate this mystery of nature."

Giessen, Sept. 1858.

POSTSCRIPT.

In the course of the present summer I have been no more successful than last year in discovering male Bark-lice, or even detecting any trace of their existence. The only thing that I can add to the preceding statements, is that the comparative time of the evolution varies considerably according to external circumstances. Whilst, last year, the second winged generation made its appearance only in August, I observed it this year as early as the end of June.

Giessen, July 12, 1859.

EXPLANATION OF PLATE VII.

Fig. 1. Sexual apparatus of the winged female of *Chermes Laricis*.
Figs. 2 & 3. Lower part of the single sexual passage of *Chermes Abietis*, with the two lubricating glands.
Fig. 4. The same part in *Phylloxera Quercus*.

XLII.—*Observations on the genus* Sacculina, *Thompson* (Pachybdella, *Diesing*; Peltogaster, *Rathke*). By R. LEUCKART*.

[With a Plate.]

IN his "Travelling Observations in Scandinavia †," and "Contributions to the Fauna of Norway ‡," Rathke has described, under the new generic name of *Peltogaster*, two species of a very peculiar flat and sac-like parasite, which is attached, by means of a "sucker-like structure," to the abdomen of the *Paguri* and of certain Brachyurous Crustacea. Rathke regarded this remarkable animal as a worm, but at the same time indicated (at least in the anatomical description contained in the memoir first quoted above) certain analogies with *Cyclops* and the *Lernææ*.

* Translated from Wiegmann's 'Archiv,' 1859, p. 232, by W. S. Dallas, F.L.S., Keeper of the York Museum.

† Neueste Schriften der naturf. Gesellsch. in Danzig, 1842, Bd. iii. Heft 4, p. 105.

‡ Verh. der K. L. C. Akad. Bd. xx. Abth. i. p. 245.

He also remarks expressly that *Peltogaster* can hardly be placed in the same group with the true suctorial worms and Trematoda, which it approaches as regards its organ of adhesion. Notwithstanding this, however, and although in the interim the similarity of *Peltogaster* with "the parasitic females of some of the lower Crustacea" had been pointed out by me*, we find our animals placed amongst the Leech-like parasitic worms in the 'Systema Helminthum' published by Diesing some years afterwards (1850), and now indeed distributed into two genera,—the species with a terminal sucking-disc found by Rathke under the abdomen of *Carcinus Mænas* being formed into the type of a new genus, *Pachybdella,* Dies. (*P. Rathkei,* Dies., *Peltogaster Carcini,* Rathke).

That this attempt at a systematic arrangement is a mistake, cannot be a matter of doubt to any one after the critical and historical remarks of Steenstrup†. Steenstrup proves that the animals in question were not only discovered by Kröyer ‡ on *Pagurus* and *Hippolyte* simultaneously with Rathke, but were already described and figured unmistakeably by Cavolini § in the last century. Cavolini also observed the young of our animals, which at certain times issued in abundance from the free opening of the body regarded by Rathke as the mouth. He even recognizes their unmistakeable similarity to the larval forms of the *Cyclops*. But that the sacs from which these larvæ proceeded were animals, and, indeed, the parents of the larvæ, remained unknown to the Italian observer; he regarded them as mere ovisacs which were in this case abnormally attached to a strange animal (*Pagurus*). Both by Kröyer and Rathke the animal nature of the sacs in question was certainly recognized; but their relations remained almost equally uncertain to the Danish zoologists. In their opinion, these parasites form a new genus with several species (Kröyer was acquainted with three from *Pagurus pubescens, P. Bernhardus,* and *Hippolyte pusiola*), which, on the one hand, appears to have some analogy with the *Lernææ,* but, on the other, possesses a certain affinity also to the *Hirudinea* and other Entozoa.

Some years after Rathke and Kröyer, the same creatures, as Steenstrup remarks, were also observed by Bell ‖ on the abdomen of *Carcinus Mænas* and *Portunus marmoreus,* from the English Channel, and cursorily described by him. Bell appears

* Morphol. der wirbellosen Thiere, 1848, p. 72, note 2.

† Wiegmann's Archiv, 1855, p. 15; translated in Ann. Nat. Hist. 2nd. ser. vol. xvi. p. 153.

‡ Monogr. der nordischen *Hippolyte*-Arten, in Vid. Selskab. Naturv. og Math. Afh. ix. D. p. 56.

§ Abh. über die Erzeugung der Fische und Krebse, p. 161. taf. 2.

‖ Hist. Brit. Crust. 1845, p. 108.

not to have been acquainted with the labours of his predecessors; he enters into no discussion of the systematic nature of the parasites observed, but remarks that the pit by which they are attached is probably to be regarded as the mouth, and the second free opening (mouth according to Rathke) as the anus.

I am happy that it is in my power to add to the preceding observations, made known by Steenstrup, another, made in the year 1836, which is the more important as it reposes upon a perfectly natural notion of our animals, and also introduces them into the system under the generic name of *Sacculina*. The observation is due to Thompson, whose numerous important discoveries have, singularly enough, nearly all been destined to remain for a long time unnoticed, and to fall into almost complete oblivion. Unfortunately, I know the memoir of our author (which was published in the 'Entomological Magazine,' iii. p. 452) only from Wiegmann's 'Jahresbericht' (1837, p. 248), in which, however, it is treated with a certain degree of mistrust. I learn from it that Thompson observed on the abdomen of *Carcinus Mænas* a new parasitic Crustacean "belonging to the Lernæadæ," which hung down by a neck-like process between the membranous interstices of the tail of the Crab, "like a bilobed leathern bag." From the wide orifice a granular substance was pressed out, which, under the microscope, proved to be a mass of larvæ, "resembling those of *Lernæocera* *."

So far the report. It is unmistakeably the *Peltogaster Carcini* that is here described; and there is no doubt that this animal, from the form of its larvæ, its mode of life, and *habitus*, belongs to the *Lernæadæ*, although the circumstance that the larvæ are excluded within the body of the mother must certainly be regarded as a remarkable departure from the other animals of this group. Consequently, if we restore the name *Sacculina* either for *Peltogaster* in Rathke's sense, or at least for the form characterized by Diesing as *Pachybdella*, we are only discharging an old and almost superannuated debt.

That Thompson's view was perfectly correct, has also sub-

* Thompson does not regard his *Sacculina* as belonging to the *Lernæadæ*, but says "that it agrees with no tribe of the *Crustacea*;" and, from his remarks, he seems to think that its nearest affinity is with Cirripedes. He compares the larva with *Argulus armiger* of Latreille, a microscopic Crustacean discovered by Slabber. He appears also to regard the *Sacculina* as hermaphrodite, saying that its body is "entirely filled with the ovaria, and an enormous testicular gland." His ovaria evidently correspond with the organ described in the text as the "brood-chamber," and his "testicular gland" is evidently identical with the cordate body described by Leuckart as containing the true ovary and cement-gland.—W. S. D.

sequently been confirmed by the investigations of Oscar Schmidt*. Schmidt likewise observed the larvæ of *Peltogaster* (*Sacculina*) *Carcini*, and by that means, independently (without knowing any other investigations than those of Rathke), arrived at a certain conviction that here we have to do with a Crustacean of the group *Parasita*.

The similarity of these animals with the *Lernæadæ* could not escape Steenstrup; but, unacquainted as he was with the investigations of Thompson and Schmidt, by putting together *Peltogaster* and a parasite withOnisciform young also observed in Crabs by Cavolini, and by the apparently accordant statements of Rathke that a small Onisciform Crustacean, described as *Liriope pygmæa*, Rathke, sometimes occurred in the brood-cavity (*Bruthöhle*; stomach of Rathke), he allowed himself to be misled into arranging our parasites with the Isopod genus *Bopyrus*.

It is, however, scarcely to be doubted that Steenstrup has now given up this opinion, especially since Kröyer† and Lindström‡ have published their observations on the larval state of the species of *Peltogaster*, which are exactly conformable with the other statements. It appears, however, from the investigations of the former, as though the young state of the different species presented many diversities; at least, he states that the larva of one species of *Peltogaster*, and of the small and globular form parasitic upon *Hippolyte* (*Sylon*, nov. gen.) belonged to a more advanced period of development than those of a second species of the genus *Peltogaster*, which latter (as may also be asserted of those of the genus *Sacculina*, according to Schmidt) agree closely with Cavolini's figures, that is to say, present a so-called *Nauplius*-form. The anatomical investigations furnished no decisive result, and left the author himself in doubt as to the existence of a mouth.

I have had but few opportunities of observing these remarkable animals,—first at Heligoland in the year 1846, afterwards at Nice, and again a few weeks ago, in company with Dr. Pagenstecher of Heidelberg, at Heligoland. The first time I met with *Peltogaster Paguri*, Rathke, at the latter place, and the second time with a *Sacculina*, but of each only a single example. The *Sacculina* was attached, as usual, to the tail of a Crab, *Hyas*

* Zeitschr. für die ges. Naturwissenschaften, Halle 1853, p. 101; Handatlas der vergl. Anat. taf. x. fig. 7; a third memoir in the Journal the 'Weltall,' 1854, p. 19, is still unknown to me.

† Öfvers. Kongl. Dansk. Vid. Selskab. Förhandl. 1855, p. 127, translated in Zeitschr. für die ges. Naturwiss. viii. p. 419. This paper of Kröyer's is, however, only to be regarded as a preliminary one. I do not know whether a more complete memoir by our author has since appeared.

‡ Öfvers. Kongl. Vetensk. Akad. Förhandl. 1856, xii. p. 361.

Aranea, on which, as far as I know, it has not yet been observed. It was of moderate size, 6 lines long and the same in breadth; in its form it differed so much from the ordinary *Sacculina* that I think I am justified in describing it as a distinct species (*Sacculina inflata*, n. sp.). The dorsal and ventral surfaces were considerably arched; and the posterior orifice, which is extraordinarily extensible, was situated upon one of the surfaces at some distance from the margin of the body (Pl. VII. fig. 5).

Although, by the anatomical examination of this single specimen, I by no means obtained even an approximately complete insight into the structure of this animal, some remarks upon it may not be out of place here, considering the complete uncertainty of our present knowledge.

In the first place, I have scarcely any doubt that the so-called sucking-pit of our animal is actually the mouth. This view is especially supported by the fact that this so-called sucking-pit does not, as would be supposed from the previous descriptions, merely adhere to the body of the Crab externally, but, with its funnel-shaped margins, completely penetrates the integuments in the membranous interstices between two segments, so that the tolerably wide and gaping orifice surrounded by these margins stands in direct communication with the cavity of the body of its host. No mandibuliform structures or projections could, however, be detected on these margins. That the fluids of the cavity of the body of the Crab pass into the interior of our *Sacculina* is, under these circumstances, a matter of course*. Close behind the oral funnel, as also in the posterior extremity of the body of this parasite, a broad and clear space (that is to say, a space filled with colourless fluid) was seen shining through the integuments, which can hardly be anything but the intestinal canal filled with the blood of the Crab. This space attained its greatest development at the hinder extremity of the body, where it extends above the middle on the dorsal surface (the surface turned from the posterior orifice). It is true that after the opening of the *Sacculina*, when the fluid just mentioned flowed out, no structure could be found, amongst the confusion of the masses floating in the interior, that could be recognized with certainty as an intestine, or even as a reservoir of the above fluid; but if we consider that even in *Lernæa*, the wall of the

* According to recent observations by Wright and Anderson (Edinb. New Phil. Journal, vii. p. 312), a canal rises from this oral orifice in *Peltogaster Paguri*, which, after entering the body of the host, becomes much ramified, and penetrates this in every direction. [Thompson says, "On removing them (the parasites) by force, the neck presents the appearance of irregular branched joints, and a large opening is seen, which has every appearance of being continuous between the rectum of the Crab and the cavity of the parasite."—W. S. D.]

intestine, which is destitute of a muscular coat, possesses little to characterize it, this negative result must not be estimated at too high a value, especially considering the other circumstances that occur here.

The external integuments consist of a thick and resistent yellowish chitine-layer, which has not the least resemblance to the integuments of the worms, but in its appearance and physical behaviour closely approaches the chitinous shield of the Arthropoda. From its appearance under the microscope, one might almost suppose that it is composed of numerous membranes stuck together and much folded,—a supposition which acquires still more probability from the fact that similar thin and folded chitine-lamellæ are also to be met with in abundance in the interior of our animal, especially in Rathke's ovaries.

Segmentation, as is well known, is wanting in the *Sacculinæ*; the chitinous skin is throughout of the same thickness and nature. Beneath the chitine coat there lies, besides the ordinary epidermoidal cellular layer, a tolerably thick whitish layer, which separates readily from the outer integuments, and appears to be a sort of fatty body, or a cutaneous muscular sac permeated by fat. In it, besides numerous cellular bodies and granules, we find the above-mentioned chitinous lamellæ, and single broad muscular fibres with most beautiful transverse striation. In the part surrounding the posterior orifice, these muscular fibres attain their greatest development; they become developed here into a regular sphincter, which is so powerful, that, in the contracted state, it forms a distinct wart-like elevation (fig. 5). During life, the body of the animal is very frequently seen in slow undulating movement, which is evidently the result of the cooperation of the cutaneous muscles.

The posterior orifice (which in *Peltogaster* with a ventral mouth is turned forwards, that is, towards the head of the host and the orifice of the shell) is certainly not the mouth, as Rathke supposed, but rather a cloacal aperture. It does not lead into the alimentary organ, but into the brood-chamber of our *Sacculinæ*. This cavity occupies by far the greater part of the whole body, and has its own chitinous walls, which pass over, at the margin of the orifice, into the external integument, and, during the contraction of the sphincter, form a number of radiating folds at this point. The thickness of this chitinous wall is certainly much less than that of the external integuments, but still very considerable.

The contents of this brood-chamber consist of a great quantity of flat bands, of about 1 line in breadth on an average; these issue from each other in an irregular dichotomous ramification.

(fig. 6), and, being repeatedly bent and coiled up, fill the entire space of the cavity, without, however, being anywhere firmly connected with its walls. When unfolded, it appeared as if all these bands composed only a single body, repeatedly ramified, like a *Flustra*.

Even with the naked eye, these bands are seen to consist of an aggregation of small globules; on examination with the microscope, the globules proved to be ova, which were united together by a common clear and structureless interstitial mass. This interstitial mass formed, to a certain extent, a framework, each of the spaces of which contained an egg, just as is the case in the ovisacs of *Cyclops*. There could not be the least doubt that the body in question constituted a band-like and much-ramified egg-tube, which in this case, instead of hanging freely down from the body as in other allied animals, was enclosed in a peculiar brood-chamber.

The ova were nearly all in the same grade of development. They contained a *Nauplius*-like embryo with a single eye, like *Cyclops*, and with three pairs of long natatory feet. They did not seem to have attained their complete development, as indeed appeared from the fact that not a single free embryo was to be found in the brood-chamber. As the attempt to free the embryos from their egg-shells by pressure under the glass cover was also unsuccessful, I am unfortunately not in a position to state anything more exactly with regard to their form and structure.

The viscera remaining in our *Sacculinæ* after the removal of this egg-tube (which was previously seen both by Cavolini and Rathke) consisted, besides the above-mentioned fatty body and the membranes of the brood-chamber, of a large cordate body of compact structure, which lay upon the ventral surface (that furnished with the cloacal aperture), and terminated with its posterior pointed end close in front of the cloacal aperture. It seemed as if this body was to a certain extent lodged in the chitinous walls of the brood-chamber. At any rate, it cohered with this membrane, and, on the other hand, presented similar relations to the fatty body above mentioned.

The organization of this body is very complicated, and was but imperfectly unravelled. It consists of a framework of chitinous lamellæ, which pass through it in various directions, and form a kind of lattice, such as is indeed figured by Rathke, but represented as far too regular. In the interstices of this framework there is a mass the analysis of which is difficult, in which, however, two kinds of structures could be distinctly recognized. One of these structures was the ovary; the other, no doubt, the cement-gland.

The ovary consists of a confused mass of numerous cæcal tubes; it is therefore probably similar in structure to that of the other parasitic Crustacea. Here and there closed sacs with jagged processes were also met with, just as has recently been described by Claus in *Chondracanthus**.

The ovarian eggs were usually smaller than those of the egg-tubes, and partly also still destitute of a membrane. The germinal vesicle could only be rendered distinct with difficulty amidst the numerous larger and smaller oil-drops of the tenacious yelk. (Considering the relation which subsists, in allied forms, between the ovary and the intestinal membrane, the nucleus of our animals might also enclose within it a portion of the intestine.)

The cement-gland, which accompanies the tubes of the ovary almost everywhere, appears, in its peripheral portion, as a cylinder of 0·21 millim. in diameter, branched like a stag's horn. Its thick walls are formed by closely approximated cylindrical cells, having a transverse diameter of 0·01 millim. and a length of 0·035 millim., and continued at the centre of their extremity into tail-like processes of considerable length. The contents of these cells consist of a strongly refractive substance. An external envelope could not be detected upon these walls; it appeared as if they were only held together by the agglomeration of the cells.

With regard to the efferent terminations and orifices of these glands, nothing could be ascertained with certainty; but future observers may probably be led into the right track by the two pairs of lateral orifices discovered by Rathke. Even Rathke regarded one pair of these apertures as the openings of the ovary. As to the second aperture, he was in doubt whether it formed the issue of cement-glands, or of male organs, but decided at last in favour of the latter, although he had no definite ground for this course.

Nothing can now be urged in favour of the hermaphroditism assumed by Rathke, especially as, in my investigations, no trace of seminal filaments could be discovered. The existence of dwarfed males in the brood-chamber is far more probable, but my investigations in this direction furnished no result.

EXPLANATION OF PLATE VII.

Fig. 5. *Sacculina inflata*, laid upon its back; natural size.

Fig. 6. A portion of the ramified ovisac; natural size.

* Ueber den Bau und die Entwickelung parasitischer Crustaceen; Cassel, 1858, p. 13.

XLIII.—*Descriptions of two Coleopterous Insects from the North of China.* By T. Vernon Wollaston, M.A., F.L.S.

The two insects the descriptions of which I have given below were collected by Mr. Fortune in the north of China; and I propose to dedicate them to my learned and excellent friend the Barão do Castello de Paiva, Professor of Botany in the Académie Polytechnique of Oporto, and a member of many scientific societies both in Portugal and France, whose botanical researches in Madeira and the Canary Islands have been so long and so justly appreciated by the leading naturalists of his own country.

Fam. Melolonthidæ.

Genus *Hoplia*, Illiger.

Hoplia Paivæ.

H. subovata, supra depressa nigra, prothoracis limbo, linea centrali lineaque breviore intermedia necnon elytrorum sutura fasciisque tribus transversis squamis subviridescenti-albido-luteis dense vestitis, antennis pedibusque rufo-ferrugineis plus minus vestitis, illarum clava obscuriore.

Variat corpore (supra et infra) squamis pallidis vestito, lineis fasciisque plus minus suffusis.

Long. corp. lin. 3½–4.

H. subovate, beneath exceedingly convex and densely clothed with yellowish-white scales, having an iridescent or greenish tinge; above much depressed, black; but more or less beautifully variegated with paler scales of the same colour as those below. *Prothorax* with the margins, a central line, and a shorter intermediate one on either side (connected with the anterior margin, but not reaching to the hinder one), covered with pale scales. *Elytra* with the suture and three transverse fasciæ (sometimes distinct and sometimes interrupted) likewise pale. *Limbs* rufo-ferruginous, and more or less clothed with paler scales; the *club* of the *antennæ* darker.

[In some specimens the entire upper surface appears to be almost clothed with paler scales, leaving the bands and fasciæ exceedingly obscure; nevertheless even in examples such as these their form is more or less traceable.]

Fam. Erotylidæ.

Genus *Languria*, Latreille.

Languria Paivæ.

L. obscure cyanea, nitida, ubique punctulata, prothorace convexo rufo maculis quatuor rotundatis distinctis necnon per marginem

posticum maculis quatuor minoribus plus minus confluentibus ornato, elytris læte cyaneis striato-punctatis.

Long. corp. lin. 6½.

L. dark cyaneous, shining, and free from pubescence. *Head* deeply and closely punctured. *Prothorax* much more sparingly (and less deeply) punctured, with a very short deep oblique fovea on either side behind, bright rufous, with four large rounded spots (two of which are on the disk, and the other two further apart, towards either anterior angle), and with four smaller ones along the hinder margin (the inner two of which are confluent at their base), dark: the extreme hinder margin itself, and the centre of the fore margin, more or less, also dark. *Elytra* brightly cyaneous, finely and regularly striate-punctate, and with the interstices closely and minutely punctulated. *Body beneath* punctured (the abdomen densely so), dark cyaneous, with the anterior portion of the metasternum rufous.

XLIV.—*On some new Anthribidæ.* By Francis P. Pascoe, F.L.S. &c.

[Continued from p. 333.]

Apolecta.

Head exserted, oblong, convex in front, with a short broad rostrum widely emarginate at the apex. Antennæ approximate, very long, slender, filiform, arising from a large semicircular cavity in front of the rostrum and beneath the eye, the first joint long and much thicker than the rest, the second short, a little tumid at the apex, the rest perfectly linear. Eyes distant, lateral, round, entire. Labrum slightly emarginate. Terminal joint of the maxillary palpi elongate, obconic; of the labial, ovate. Prothorax narrowed anteriorly, the carina forming an angle in the centre towards the base, gradually receding as it approaches the side, where it curves forward to about half the length of the prothorax. Elytra convex, rather wider than the prothorax, the sides subparallel. Legs slender.

This genus has for its type the *Mecocerus*? *parvulus* of Mr. Thomson (Arch. Ent. tom. i. p. 437), which differs in many respects from the true *Mecoceri*,—*i. e.* in the form and insertion of the antennæ, rostrum, carina, &c.

Apolecta has a very wide range, being found in Ceylon, Java, Malacca, Borneo, and Aru; but all the species have been hitherto unpublished, except the two here mentioned.

Apolecta gracillima.

A. rufo grisea, nigro-maculata; elytris plaga magna communi pone

medium, pedibus antennisque (articulis duobus ultimis exceptis) nigris.

Hab. *Singapore.*

Oblong, with a reddish grey or a pale dull orange pile; spot between the eyes, three stripes on the prothorax, a large transverse patch common to both elytra posteriorly, and a few small spots, principally on the shoulders and base, black: antennæ above five times as long as the body, black, except the last two joints, which are white. Length 3 lines, of the antennæ 15.

Habrissus.

Head oblong, with a short broad rostrum, prolonged at the apex. Antennæ short, slender, arising from a groove midway between the eye and mandible, the first two joints short and slender, the last three forming a very moderately thickened club. Eyes round, entire, scarcely approximate. Lip rounded anteriorly. Mandibles stout, triangular. Palpi slender, pointed. Prothorax narrow in front, gradually enlarging to the carina, which is subbasal and divided at the side into two short divergent branches. Scutellum very small. Elytra oblong, convex, slightly rounded at the sides. Legs moderate, first tarsal joint as long as the rest together. Mesosternum short, broad, slightly bilobed behind.

A genus which has a strong resemblance, particularly as to the antennæ, to the South American *Corrhecerus*, from which, however, it differs in its entire eyes, prolonged apex of the rostrum, which is terminated by the small lip (almost descending to the external margin of the mandibles when closed), and dichotomous termination of the carina.

Habrissus pilicornis.

H. ovato-oblongus, cinereus, fusco varius, tarsis fulvescentibus, unguibus nigris.

Hab. Aru.

Ovate-oblong, covered with a short, dense, ashy pile, varied with dark brown patches, head and prothorax tinged with yellow, the brown on the latter forming a series of indistinctly curved and slightly connected spots; elytra punctato-striate, a brownish patch on the anterior two-thirds, in which are several ashy spots, then a band of the same colour, followed by another brownish patch, the apex also ashy; pygidium ashy, with a black spot on each side; legs ashy, tibiæ at the base and apex, and claws black: antennæ with a few long scattered hairs, black, the first two joints reddish yellow. Length 5 lines. British Museum.

Basitropis peregrinus.

B. elongato-parallelus, dense tomentosus, fuscus fulvescente varie-

gatus; pedibus obscure brunneo-testaceis; abdomine infra griseo-subsericeo.

Hab. Port Essington.

Elongate-parallel, covered with a dense dark brown tomentum varied with pale yellowish grey, particularly on the elytra, where it also forms an obscure band near the apex; legs dull testaceous brown; body beneath with a pale greyish pile, the abdomen subsericeous; antennæ very stout, tomentose. Length 3½ lines.

Basitropis ingratus.

B. **ovato-oblongus, tomentosus, fuscus, lutescente-variegatus; pedibus griseo-variis; abdomine griseo-picta, lateribus fusco-maculatis.**

Hab. Port Essington.

Ovate-oblong, tomentose, dark brown obscurely varied with dull ochreous; legs varied with reddish-brown and grey; body beneath sparingly covered with coarse greyish hairs, abdominal segments with a reddish-brown spot on each side; antennæ reddish-brown, slightly tomentose, comparatively slender. Length 2½ lines. British Museum.

Basitropis has hitherto been a stranger to Australia; the two species described above are therefore interesting additions to its scanty list of Anthribidæ.

Basitropis mucidus.

B. **oblongus, piceus, fuscus, obscure griseo-varius; prothorace basi lateribus rectis.**

Hab. Borneo.

Oblong, pitchy, with a sparse pubescence sprinkled with dark brown and grey in nearly equal proportions, but everywhere showing the glossy surface beneath; sides of the prothorax at the base nearly straight; antennæ and legs dull ferruginous obscurely varied with grey, the first and second joints of the club as long as they are broad. Nearly allied to *B. nitidicutis* of M. Jekel, but is much shorter and proportionably stouter. Length 3½ lines.

Eucorynus Stevensii.

H. **oblongus, hirtus, fuscus, griseo-varius; antennis rufo-brunneis, clava nigra; tarsis griseo-annulatis.**

Hab. Dorey.

Oblong, slightly depressed; head dull greyish mixed with brown; prothorax finely punctured, dark brown with a few greyish spots; elytra punctured in rows, dark brown mixed with greyish, principally near the apex; antennæ about half the length of the body, dull reddish-brown, the club black; legs dark brown

with greyish rings, which are most marked on the tibiæ; under surface dull brown. Length 4 to 6 lines.

Dedicated to Samuel Stevens, Esq. of Bloomsbury Street, to whom I owe my best thanks for many valuable specimens.

Eucorynus setosulus.

E. oblongus, hirto-setosus, fuscus, albo-irroratus; pedibus albo-annulatis; antennis nigris, articulo septimo albo.

Hab. Philippine Islands. (Manilla ?)

Differs from *E. Stevensii* in its coarser and decidedly setose hairs, deeper and larger punctures, longer and thicker antennæ, and in its more lengthened form. British Museum.

APATENIA.

Head narrow, the rostrum lengthened, broad, with a short central costa, the apex entire. Antennæ inserted at about midway between the rostrum and mandibles, scarcely longer than the head, the first two joints thick, the third to the sixth more or less cylindrical, the seventh and eighth subtriangular, the ninth, tenth, and eleventh forming a club the first two joints of which are triangular and the last ovate. Eyes large, obliquely lateral, ovate, entire. Mandibles robust, strongly toothed. Palpi slender, pointed. Labrum narrow, elongate. Prothorax slightly transverse, narrow in front; carina sub-basal, extending at a right angle to about halfway along the side of the prothorax. Elytra slightly depressed. Legs moderate, tarsi rather short. Mesosternum rounded posteriorly.

Apatenia viduata.

A. cinereo-nigra, subargentata, maculis atro-velutinis ornata; pedibus griseo-variis.

Hab. Borneo.

Oblong-ovate, ashy black, with a slight silvery tint in certain lights; head thickly punctured, two black spots between the eyes; prothorax pubescent, indistinctly clouded with four or five black patches, a well-defined ochreous spot posteriorly; scutellum small, triangular; elytra slightly depressed, regularly punctate, rather wider than the prothorax, finely tomentose, with a few black velvety spots, and a large one on each behind the middle; legs obscurely varied with ashy; under surface dull black. Length 4 lines.

MISTHOSIMA.

Head rather broad in front, the rostrum subquadrate, rather short, entire at the apex. Antennæ slender, shorter than the body, arising from a large rounded cavity below and a little in

front of the eye; the two basal joints tumid, the last three forming a slender interrupted club. Eyes distant, nearly round, entire. Palpi slender, pointed. Labrum transverse, rounded anteriorly. Mandibles slender, toothed. Prothorax transverse, rounded in front and at the sides; the carina basal, terminating in a short curve at the side. Scutellum small, rounded posteriorly. Elytra oblong, convex, parallel with the base of the prothorax. Legs slender, anterior pair the longest; first tarsal joint longer than the rest together. Mesosternum short, slightly rounded posteriorly.

Misthosima mera.

M. oblongo-ovata, rufo-brunnea, griseo-pubescens; pedibus fulvo-ferrugineis.

Hab. Borneo.

Oblong-ovate, reddish brown, covered with a greyish pile, which appears to be rather easily rubbed off, then giving the specimen a mottled appearance; antennæ with two basal joints reddish yellow, the rest gradually darker, the club black; legs and body beneath dull yellowish red, slightly pubescent. Length 2 lines.

Misthosima marmorea.

M. oblonga, fusca, griseo-pubescente-varia; pedibus ferrugineis.

Hab. Borneo.

Oblong, dark brown, variegated with a greyish pubescence, *i. e.* little straggling patches composed of short, scant hairs: antennæ with the two basal joints reddish yellow, the remainder, with the legs, ferruginous. Length 2 lines.

PLINTHERIA.

Head narrow, gradually contracting below the eyes, the rostrum long, expanding towards the apex, which is broadly emarginate. Antennæ as long as the body, arising from a scarcely perceptible groove nearly at the extremity of the rostrum; the second joint longer than the first and not thicker than the third, which is longest, the remainder to the eighth slightly but gradually decreasing in length, the last three forming a short compact club. Eyes round, entire, prominent. Labrum rounded. Mandibles short, triangular. Palpi rather long, pointed. Prothorax about equal in length and breadth, narrowed in front, contracted posteriorly; carina sub-basal in the centre, then bending slightly forwards and terminating in a short curve at the side. Scutellum small, triangular. Elytra short, convex, wider than the prothorax at the base. Legs moderate, the anterior longest, the first tarsal joint longer than the rest together.

Plintheria luctuosa.

P. nigra, albo-variegata; tibiis, apice excepto, fusco-testaceis; antennis rufo-variis, clava nigra.

Hab. Dorey.

Oblong-ovate, brownish black varied with patches of whitish hairs, particularly on the elytra, which in some specimens assume a tessellated appearance; head and rostrum coarsely, the apex finely punctured; prothorax with close shallow punctures; elytra deeply and regularly punctured; legs black, the basal two-thirds of the tibiæ and antennæ dull reddish brown, the club of the latter black. Length 2½ lines.

ESOCUS.

Head rather broad in front, contracted below the eyes; the rostrum of moderate length, slightly dilated at the apex, which is entire, and with a short central costa. Antennæ short, arising from a shallow groove above the dilated apex, the first two joints thick, of nearly equal length, the third longer, the rest rapidly decreasing to the eighth, the last three forming a short, broad, compact club. Eyes distant, prominent, oblong, entire. Labrum rounded anteriorly. Prothorax narrow in front, gradually wider towards the base, the carina sub-basal, shortly recurved at the side. Scutellum small, transverse, rounded posteriorly. Elytra wider than the prothorax, subgibbous towards the base. Legs of moderate length, first tarsal joint as long as the rest together.

Esocus lachrymans.

E. niger, subnitidus, guttis elongatis albo-pubescentibus ornatus.

Hab. Borneo.

Oblong-subovate, black, slightly shining, with elongated white hairy spots; head minutely punctured, the rostral costa very nearly central; prothorax slightly punctured, with three principal vittiform spots; elytra gibbous behind the scutellum, with remote rows of shallow punctures; antennæ and legs entirely black. Length 3 lines.

HUCUS.

Head broad in front, swollen at the side below the eye; the rostrum rather short, ending in a large transversely subquadrate, entire apex; between this and the eye, on each side, a strongly-marked costa. Antennæ short, arising from the middle of the rostrum directly above its dilated apex, the first two joints thick, of nearly equal length, the third longest, the last three forming an elongate, slender, pointed club. Eyes subapproxi-

mate, frontal, large, round, entire. Labrum rounded anteriorly. Prothorax narrowed in front, the side nearly straight, the carina sub-basal, arched forwards, forming an acute angle at its flexure and continued but a short way on the side of the prothorax. Scutellum very small, transverse, rounded behind. Elytra short, convex, the sides slightly rounded. Legs of moderate length, the first tarsal joint much longer than the rest together.

Hucus melanostoma.

H. ovatus, fuscescente-pubescens, griseo-varius; oculis, rostro, mandibularum apice nigris.

Hab. Borneo.

Ovate, head and prothorax with a ferruginous-brown pubescence mingled with grey, especially on the sides of the latter, on the elytra a darker brown in longitudinal patches partially enclosed by the grey, while posteriorly this latter is surrounded by the brown; eyes, rostrum, and tips of the mandibles dull black; legs and antennæ ferruginous, obscurely clouded with dark brown. Length 1½ line.

PHAULIMIA.

Head rather broad in front, narrower below the eyes, rostrum short, quadrate, entire at the apex. Antennæ arising from a lateral groove midway between the eye and mandible, very short, the first two joints tumid, the last three forming a broadly dilated club. Eyes oblique, oblong, entire, not approximate. Maxillary palpi rather long, pointed. Mandibles slender. Prothorax slightly transverse, narrowed anteriorly, the carina sub-basal, forming a right angle at its flexure and terminating at about half the length of the prothorax. Elytra short, slightly depressed, the sides nearly parallel. Legs short, coxæ of the anterior only slightly approximate, the rest distant, tarsi with the first joint as long as the rest together.

Phaulimia ephippiata.

P. griseo-rufa, obscure fulvo-varia; elytris macula magna communi basali fusca.

Hab. Borneo.

Ovate, pubescent, slightly depressed, pale greyish red, obscurely varied with fulvous; on the prothorax the darker colour is confined to a few oblique patches, on the elytra it is tessellated on the interstices formed by the punctate striæ, and at their base a large dark brown spot; antennæ and legs yellowish red, the club black. Length 1½ line.

Dysnos.

Head moderate, rounded at the sides, with a very short broad rostrum but slightly emarginate at the apex. Antennæ shorter than the body, arising from an oblique groove below and a little in front of the eye; the first two joints tumid, of nearly equal length, the last four forming an elongated interrupted club which terminates in a subulate process. Eyes lateral, ovate, oblique, slightly emarginate, not approximate. Labrum and mandibles small. Palpi short, pointed. Prothorax wider than the elytra at the base, longer than broad, rounded slightly at the sides, convex above; the carina nearly basal, forming an obtuse angle at its flexure, and continued to within a third of the anterior margin. Scutellum very minute. Elytra convex, the sides nearly parallel. Legs short, the second and third tarsal joints dilated, the anterior tibiæ and tarsi longest.

Dysnos auricomus.

D. fusco-lanosus obscure aureo-varius; elytris striato-punctatis; antennarum basi pedibusque fusco-rufis.

Hab. Aru.

Subovate, scarcely elongate, covered with short dark-brown, and on the thorax nearly black hairs; with these are obscurely interspersed others of a golden yellow or greenish hue, the effect of which, under a strong lens and in a certain light, is to give the appearance of dark spots on a light ground; eyes brown; antennæ slightly ciliated, the base brownish red, the club black; legs dull reddish brown; under surface pitchy, closely punctured. Length 2 lines.

Aræcerus rufipes.

A. ovatus, fusco-tomentosus; capitis fronte griseo; elytrorum interstitiis prothoraceque nigris, his fulvo-maculatis; antennarum funiculo pedibusque rufis.

Hab. Borneo.

Ovate, covered with a dark brown tomentum; front of the head with greyish hairs; prothorax black, slightly varied with grey; elytra with the alternate interstices elevated, black, spotted with fulvous; antennæ yellowish red, the club black; legs dull yellowish red. Length 2 lines.

Aræcerus areolatus.

A. late ovatus, nigro tomentosus; elytrorum interstitiis cinereo-maculatis; antennis basi rufis; pedibus nigris.

Hab. Borneo.

Broadly ovate, covered with a black tomentum; elytra with

the alternate interstices elevated, pure black, spotted with ashy; antennæ reddish only at the base; legs black. Length 2 lines.

Besides the difference in colour, which in this genus is perhaps not very important, and the greater width, which attains its maximum at the junction of the prothorax with the elytra in this species, whilst in *A. rufipes* it is at about the upper third of the elytra, it is also distinguished by the joints of the club being very decidedly longer; both are also very nearly allied to *Aræcerus** *Coffeæ*, F., which, however, is smaller and more convex, with proportionably longer antennæ, and generally has a patch of several longish grey hairs on the shoulders; from this I find it difficult to distinguish *Tropideres fragilis* of Mr. Walker, from Ceylon, the type of which is in my collection.

XLV.—*On the Arrangement of Zoophytes with Pinnated Tentacles.* By Dr. J. E. Gray, F.R.S., V.P.Z.S., Pres. Ent. Soc., &c.

Considerable attention has been paid by various authors to the arrangement of the stony Corals (*Actinaria*), by MM. Milne-Edwards and Haime, and by Mr. Dana among others; but comparatively little progress has been made in the arrangement of the Zoophytes with pinnated tentacles, or *Alcyonaria*, since the time of Lamarck.

I have for years been studying these animals and the corals which they form, and have only been prevented from publishing the result of my studies by the desire to feel more sure with regard to the distinction between the species of the family of Gorgoniadæ, and to ascertain with greater certainty than I have yet been able the true synonymy of the species of the genera of that family.

In the meantime I would suggest the following arrangement of the families, as that which best explains the relation of the various genera to each other.

Order I. SABULICOLÆ.

Coral-tree symmetrical, with a simple base, supported by more or less distinct calcareous spicula, and strengthened by a single, fusiform, elongate, calcareous, central axis. Living with the base sunk in the sand or mud of the sea-coast.

Fam. 1. Pennatulidæ.

Body free, more or less pen-like, with a naked peduncle and a

* More correctly *Aræocerus*; but I hold that the orthography of the original authority ought never to be departed from, except in the case of some very gross and insufferable blunder. Schönherr first proposed *Aræcerus* in his "Curculionidum Dispositio Methodica," p. 40, and repeated it without alteration in his "Synonymia."

single central axis. The upper part with the polypes placed in transverse series on one, rarely on all sides. Axis fusiform, elongate, cylindrical and quadrangular, calcareous, as long as the coral.

Dana divides the Pennatulidæ into two subfamilies:—1. Pennatulinæ, polypes retractile; 2. Pavoninæ, polypes not retractile (including *Pavonia* and *Umbellularia*)! I may observe here that I do not think the character derived from the retraction and non-retraction of the polypes is of much importance; for it is observed that all the *Gorgoniæ* figured by Ellis from specimens preserved in spirits have the polypes expanded, and it is the same with most *Pennatulæ* and many *Alcyonia*.

I. *Penniformes*. The coral pen-shaped. The polypes in transverse pinnules, placed on each side of the ventral surface of the central rachis or stem.

Tribe 1. FUNICULINEÆ. The coral elongate, linear, slender; the pinnules small, crowded.
Funiculina. *Virgularia*. *Lygus*. *Scytalium*.

Tribe 2. PENNATULEÆ. The coral moderately broad, pen-shaped; the pinnules broad, expanded.
**Pennatula*. ***Sarcoptilus*. *Pteromorpha*. *Pteroeides*.

II. *Claviformes*. The coral club-shaped or leaf-like. The polypes scattered on one side (rarely on both) of the upper part of the club.

Tribe 3. KOPHOBELEMNONIEÆ. The coral club-shaped, with the polypes only on one surface of the club, leaving the other bare.
Kophobelemnon.

Tribe 4. VERETILLEÆ. The coral club-shaped. The polypes on all sides of the club.
Lituaria. *Sarcobelemnon*. *Cavernularia*. *Veretillum*.

Tribe 5. RENILLEÆ. The coral expanded, foliaceous, with a slender stalk. The polypes only on one surface of the expanded disk.
Renilla.

Fam. 2. Umbellulariadæ.

The body free, umbellate, with a long stem and a single central axis. The upper part with a cluster of polype-bearing cells placed in concentric series, forming a large head. Axis fusiform, elongate, as long as the stem of the coral.
Umbellularia.

Order II. SPONGICOLÆ or HYALOPHYTA.

Subsymmetrical, living sunken by the base into a sponge, strengthened by silicious spicula, and supported by a central axis formed of numerous twisted, elongated silicious fibres.

The axis is formed of many twisted fibres, its lower end tapering, and parasitically imbedded in a fixed sponge, and thus kept in an erect position.

The animal matter or bark is strengthened by silicious spicula, similar to, but shorter and thinner than the fibres of the axis. The fibres are formed of numerous thin concentric layers.

Valenciennes and other French naturalists, overlooking the structure of the spicula in the bark, have regarded the latter as a parasitic kind of *Alcyonarium* growing on some unknown substance,—an idea that requires the belief in the existence of two peculiar bodies which are always found together and are unknown in any other state, instead of regarding them as parts of the same animal growth; this is proved to be the case not only by their being always found in union, but by the fact that the axis, which is supposed to be the supporting part, is of the same texture as the spines found in the bark, the one passing gradually into the other; and I have no doubt that, in the living state, the fibres of the axis are as much surrounded by flesh as the spicula in the bark itself.

Fam. 1. **Hyalonemidæ.**

Hyalonema.

Order III. RUPICOLÆ.

Coral tree-like or expanded, fixed by an expanded base, supported by more or less abundant fusiform calcareous spicula, and often supported by a central calcareous or horny tree-like axis with an expanded base. Living attached by the base of the coral and axis to rocks on the sea-shore.

This order is divided into three suborders.

Suborder I. Lithophyta.

Coral arborescent, supported by a continuous or jointed calcareous axis, which effervesces with muriatic acid.

† *Axis continuous, not jointed.*

Fam. 1. **Coralliadæ.**

Axis inarticulate, solid, calcareous. Bark granular, with irregular-shaped spicula.

**Corallium*. *Annella*. *Ellisella*. (*Junceella* and *Ctenocella*.) ?*Gorgonella*. *Scirpearia*. *Umbracella*. ***Subergorgia*.

Fam. 2. **Primnoadæ.**

Axis inarticulate, solid. Bark formed of flat imbricate scales. Polype-cells prominent, covered with imbricate scales.
Primnoa. Callogorgia. Primnoella.

†† *Axis articulated.*

Fam. 3. **Melitæadæ.**

Axis spongy, permeated by flexuous tubular canals interrupted by harder, swollen, calcareous joints. Bark granular; cells in series on the edge of the branchlets.
Melitæa. Mopsella. ?Solanderia.

Fam. 4. **Isideæ.**

Axis calcareous, solid, divided by narrowed horny joints. Bark granular, with irregular-shaped spicula.
Isis (*Cynosaire*). *Isidella. Mopsea.*

Suborder II. Ceratophyta.

Coral arborescent, supported by a continuous (or jointed?) horny axis, which does not effervesce in muriatic acid.

Fam. 1. **Gorgoniadæ.**

Bark granular, persistent, with sunken irregular-shaped spicula, with a more or less distinct groove down each side, and with the cells in series on each side of the branchlets.

* *Coral arborescent or reticulated; cells on side of the branchlets.*

Gorgonia. Arborescent; branchlets subcompressed; cells on side, moderate.
Pterogorgia. Arborescent; branchlets much compressed; cells minute, on edge.
Rhipidogorgia. Reticulated, fan-like; cells on sides.

** *Coral frondose; cells on surface of frond.*

Hymenogorgia. Axis branched, filiform, branches separate.
Phyllogorgia. ,, ,, branches netted.
Phycogorgia. Axis expanded, foliaceous, thin.

Fam. 2. **Plexauridæ.**

Bark granular, persistent, cork-like, without any impressed lateral grooves. Cells placed equally on all sides of the branches.
Plexaura (*Bebryce*). Cells not raised, simple.
Rhinogorgia. Cells not raised, bounded by a conical process.
Eunicea. Cells more or less produced, simple.
Gonidora. Cells convex; mouth radiated.

Fam. 3. **Muriceidæ.**

Bark composed of large imbricate calcareous spicula, without any lateral grooves. Cells equally on all sides of the branchlets.
Muricea. *Plocmus?*

Fam. 4. **Acanthogorgiadæ.**

Bark thin, formed of slender filiform spicula, without any lateral grooves. Cells campanulate, on all sides of the branches, with ridges of elongated spicula, and with a number of elongate setaceous spines on the margin.
Acanthogorgia.

? Fam. 5. **Antipathidæ.**

Bark fleshy, easily deciduous, soft, simple, only strengthened by large and small, scattered, silicious? plates.
Leiopathes. *Antipathes.*

I have observed pinnate tentacles in *Leiopathes*, and indications of them in one *Antipathes*. Dana describes them as simple in two species of *Antipathes* which he saw alive; so that the position of this family is open to doubt.

Fam. 6. **Sarcogorgiadæ.**

Bark fleshy, when dry skin-like, smooth, without spicula; the edges of the cells strengthened with granular spicula.
Sarcogorgia.

Suborder III. Sarcophyta.

Coral arborescent, lobulated or expanded, only strengthened by internal or external calcareous spicula, which effervesce in acid.

Fam. 1. **Briareidæ.**

Coral arborescent, fleshy, supported by a central axis formed of numerous intertwined fusiform spicula.
Briareum.

Fam. 2. **Alcyoniadæ.**

Coral arborescent or lobed, fleshy, strengthened with imbedded calcareous spicula. Cells simple. Polype retractile or semi-retractile.
Alcyonium (Lobularia). *Sympodium.* *Ammothea.*

Fam. 3. **Xeniadæ.**

Coral expanded or arborescent, fleshy, soft, creeping or branched. Polype elongate, subcylindrical. Tentacles not retractile.
**Xenia.* *Anthelia.* *Rhizoxenia.* *Evagora.* ***Cornularia.*

Fam. 4. Nephthyadæ.

Coral arborescent or expanded, fleshy, membranaceous, often very cellular. Cell of the polypes covered externally with large fusiform calcareous spicula.

* *Nephthya* (*Spoggodia*). ? *Alcyonidia*. ** *Nidalia*. *** *Clavularia*.

Fam. 5. Tubiporidæ.

Coral calcareous, tubular. Tubes united by transverse plates formed by the expanded edges of the tubes bearing the buds. Polypes cylindrical.

ra.

XLVI.—*On the Arrangement of the Polarizing Microscope in the Examination of Organic Bodies*. By Hugo von Mohl *.

That polarized light is so rarely made use of in the microscopic examination of organic bodies, principally arises from the circumstance that the German and French microscopes, which are almost exclusively used on the Continent, are so badly arranged as to be almost valueless for detecting double refraction in those organic structures which act but feebly upon polarized light. Hence, to mention a few instances, Ehrenberg was unable to detect this property in the leaf-scales of *Olea Europæa*, and in the silicious valves of the Diatomaceæ; nor could Schacht discover double refraction in the primary membrane of the cells of plants; and Pereira, who occupied himself so much with polarized light, was unable to see the black cross in the starch-granules of rice; whilst these structures under my polarizing microscope form most beautiful objects, so that not only can I resolve the lines in *Pleurosigma angulatum* into dots, as well as with common light, but their six-sided form is quite distinct.

Even in my first attempts to use this instrument in phytotomic experiments, I found that a bright and distinct image could be obtained only by exposing the object to very concentrated polarized light. The necessity of this is evident from the fact that three-fourths of the light reflected by the mirror is necessarily lost in its passage through the polarizing apparatus, which loss must be considerably increased by the reflexion taking place at the surfaces of the lenses of the microscope. When, moreover, it is remembered that the depolarizing action of most organic structures is much more feeble than that of inorganic crystals, it may be easily understood that the image of the former is dull and imperfect, or that they remain invisible, if very intense illumination is not applied. Experiment also convinced

* Translated from Poggendorff's Annalen, No. 9. 1859, p. 178.

me that the intensity of the light can hardly be too great; hence I took especial care, in the selection of the apparatus, to ensure obtaining as much light as possible.

For this reason, and to obtain colourless light, I avoided tourmalines or Herapathite, and made use of Nicol's prisms.

In regard to the polarizing apparatus itself, it is advantageous to use, as the polarizer, a Nicol's prism of tolerably large dimensions, through which a broad beam of polarized light may pass to the objects. The illumination of the object, however, is not brighter with a large than with a small Nicol's prism; for when the polarized light, after emerging from the prism, is condensed to a luminous image upon the object by the condenser to be mentioned presently, this is equally bright, whether the prism be large or small; but the size of the image depends upon the size of the transverse section of the Nicol's prism used: hence, when this is too small, observation is rendered difficult by a small portion only of the object, lying in the centre of the field, being illuminated. The Nicol's prism need not, however, be of unusually large dimensions: a diameter of from 10 to 12 lines answers every purpose. As, however, a prism of this size is 2 inches long, care must be taken that there is sufficient room between the mirror and the stage to admit both the prism and the condensers. Hence this space should never be less than 4 inches.

As regards the position of the polarizing Nicol's prism, the question arises whether the relative direction of its oblique terminal faces to the plane of the mirror is a matter of indifference, or whether the horizontal diameter of its rhombic terminal faces should hold a definite position to the horizontal axis of rotation of the mirror. For, when all the lenses are removed from the microscope, on placing a Nicol's prism upon the eye-piece, and turning the mirror to the light, it will be found, on rotating the prism, that the light reflected from the mirror into the microscope is polarized to a considerable extent, and that a marked darkening is produced when the transverse diameter of the rhombic terminal face of the prism is parallel to the horizontal axis of rotation of the mirror, and thus also to the window through which the light proceeds. Hence, when the polarizing prism is fixed in this position under the object, less light will be transmitted to the latter than when the prism is rotated 90° and retained in this position during the observation. This circumstance is in general of no great importance; for with the bright illumination which must be provided under all circumstances, the loss of light caused by a less favourable position of the polarizer is of far less importance in regard to the brightness of the image than might at first be supposed.

Many opticians place the analysing prism immediately behind the object-glass. This certainly has the advantage of allowing the eye to be placed close to the eye-piece, so that a view of the entire field can be obtained. But this unimportant advantage is counterbalanced by decided objections, and especially by the circumstance that the sharpness of the image is more or less impaired when the light between the object-glass and the eye-piece is allowed to pass through such a massive body as a Nicol's prism, the surfaces of which, moreover, are not usually ground perfectly flat. It is therefore indisputably better to place the prism above the eye-piece, where it much less impairs the beauty of the image. The objection that the field is thus limited is of no importance, as it is easy to find a prism with which this defect does not occur, or merely at the outer margin, which is of little consequence. If the prism is fixed in a tube adapted to the eye-piece, we have, moreover, the advantage that it can be rotated on its axis at pleasure, and may be easily removed and replaced; whilst placing the prism in the tube of the microscope and rotating it within the latter is a complicated arrangement, and involves a waste of time.

Passing to the microscopic apparatus: in the case of this also the greatest possible intensity of light is the first condition of successful results. The most important point is the illuminating apparatus. As regards the mirror, an ordinary plane one may be used; but the best consists of a not too small glass prism, the section of which forms an equilateral triangle. If the surfaces of this are from 15 to 18 lines in length, that is sufficient.

It is essentially necessary that the parallel rays of light, after traversing the Nicol's prism, should be strongly condensed upon the objects. The best apparatus for this is an achromatic condenser consisting of three lenses of about 3 lines focus and large angle of aperture, such as exists in the large English microscopes. Stops are only injurious for the present purpose; but it is evident that the condenser must be capable of being placed in the direction of the axis of the microscope, so that its focus may fall exactly upon the objects. Amici, whose advice I solicited, in case he might improve my arrangements, wrote to me in the negative, considering my apparatus as satisfactory, but suggested that I might substitute a colourless flint-glass plano-convex lens, 5 lines in diameter, and with the convex side downwards, for the achromatic condenser. The result was perfectly satisfactory, especially when ordinary day-light was used, and by no means inferior to that obtained with various achromatic condensers; but when sun-light was used, as described below, this lens was not so good as the achromatic condenser. For the polarizing microscope to yield a good image, the concentration of the light upon the

object must be so great, that delicate transparent objects, such as anatomical vegetable preparations, must be almost invisible in the bright light of the field before the analyser is applied; an amount of illumination such as is used in ordinary microscopic observations is totally insufficient; and this is the principal reason why such imperfect results have been obtained by most observers with the polarizing microscope.

With regard to the object-glass, those who have several at hand will do best by using such as transmit most light. For low powers, magnifying about 200 diameters, the better kind of German object-glasses, *e. g.* the Nos. 1 and 2 of Keller's microscope, will answer every purpose; but where higher powers are required, as the $\frac{1}{4}$th, $\frac{1}{8}$th, and $\frac{1}{12}$th, the English glasses are very much the best, especially those made by Ross. The highest object-glasses will of course be used only for the most delicate objects, in which minute details are to be investigated; but, when the illumination is well managed, they transmit sufficient light to allow of the most difficult object being seen distinctly.

Equally important with the arrangement of the polarizing microscope, and the selection of the pieces of apparatus ensuring the greatest intensity of the light, is the choice of the source of the light used for illumination.

When the power required does not exceed 200 or 300 diameters, and when the object exerts considerable polarizing power (as, *e. g.*, the membrane of most vegetable cells, the fibres of spiral vessels, the granules of starch, &c.), common daylight is sufficient; and on many rather dark days in the winter I found no difficulty in making these investigations. A far more favourable result is certainly obtained, on those days when there is full sunshine, by inclining the mirror towards a part of the sky not far from the sun. The light from white cumuli also affords good illumination, except that the constant change of the brightness interrupts observation and fatigues the eyes. These sources of illumination, however, are insufficient in the case of very difficult objects, in which either a very high power is required, or which act but feebly upon the polarized light; thus, to give an instance in a well-known object, on illumination by ordinary daylight I could distinctly recognize the double refraction produced by the silicious carapace of *Pleurosigma angulatum*, but I could not detect the six-sided dots in it. In such cases it requires a far more intense illumination to obtain a bright and sharp image. In regard to this point, all may be accomplished by adopting the arrangement of the solar microscope, the direct light of the sun being received upon a mirror and allowed to fall perpendicularly upon a ground-glass plate fixed in the shutter, the condenser being so arranged that the image of this illumi-

nated glass plate coincides with the object. When low powers are used, this illumination may be too strong, which evil may easily be remedied by altering the position of the condenser; but when the higher powers are used, and the objects are very delicate, the results obtained with it are surprising. It is evident that there is no occasion to darken the room in which the observations are made.

But, as all have not the privilege of occupying a detached house, and the opportunity of making use of sun-light throughout the day, and as we are often without bright sun-light, it would be desirable to find a substitute in strong artificial illumination. Whether this is possible, I do not know. Experiments made with lamp-light did not yield satisfactory results. How far the application of Drummond's light might answer the purpose, I have not experimentally determined. I should, however, have no doubt that good results might be obtained with Drummond's light, since those obtained with lamp-light are by no means to be entirely despised; and the question is not one of the application of light of the highest degree of intensity, as with the solar microscope,—in the case of which, former experiments convinced me that the light produced by the oxy-hydrogen blowpipe and heated lime by no means forms a substitute for sun-light.

I may take this opportunity of making a few remarks upon the use of plates of selenite in observations with the polarizing microscope. When one of these is placed between the polarizer and the object, as is well known (the polarizer and analyzer being crossed), the dark field of the microscope becomes light, and presents one of the colours of Newton's rings, according to the thickness of the plate used. On viewing, under these circumstances, a doubly refracting object lying in the focus of the microscope, this, in a certain relative position to the prisms, appears of a different colour from that of the field, often of great brilliancy, and which passes into the complementary colour, when either the selenite plate or the object is rotated 90°. It is usually stated that the plate of selenite is of important value when the object but slightly polarizes light and therefore cannot be distinguished in the dark field of the microscope, or exhibits merely very obscure indications of radiation of light. In this case, after the insertion of the selenite plate in such manner that the object appears of a different colour from that of the field, and, on the rotation of the plate, passes into the complementary colour, the doubly refracting power of the object is more distinctly evident. Now I will not deny that, in many doubtful instances, this proceeding leads to a decisive result; but it is very frequently unsatisfactory, because the selenite plates are too thick, and thus act

very strongly upon the light coming from the polarizer, rendering the field too luminous, and imparting to it too intense a colour. In these cases, the difference between the intense colour of the field and the but slightly differing colour of a very delicate and feebly polarizing object is so difficult to detect, in many instances, that the use of the entire process is very doubtful. On the other hand I cannot too strongly recommend for this purpose the use of very thin plates of mica instead of the selenite. Mica being so tough and readily split, renders it an easy matter to separate such thin laminæ that, when inserted between the polarizer and the object, the field is not coloured, but merely appears more luminous; so that when a very thin plate is used, it becomes dark-grey, and the thicker the plates, the whiter the colour. If a doubly refracting object is then placed under the microscope; according to its position as regards the plate of mica, it becomes more or less brilliantly white, or more or less dark-black. These so strongly contrasted degrees of brilliancy of the object, and their difference from the uniform grey colour of the field, are more easily and distinctly perceptible to the eye than differences of colour; so that in many cases in which, when the selenite plate is used, a doubtful result is obtained, the use of the plate of mica is successful. A satisfactory result, however, is only obtained when the thickness of the plate of mica and its corresponding action upon the polarized light coincide with the intensity of the doubly refracting power of the object. The more feeble the latter, the thinner must be the plate of mica, and the less luminous it must render the field. A series of four or five plates, the thinnest of which brightens the field but little, whilst the thickest produces considerable brightness but no colour, is sufficient for all cases.

In a paper upon the examination of vegetable tissues by the aid of polarized light ('Ann. Nat. Hist.' 1858, vol. i.), I have shown that different vegetable elementary organs, having the same structure but of different chemical composition, are opposed in their action upon polarized light, one exhibiting positive, the other negative colours. To recognize this relation, the diminution of the grey colour of the object produced by the plate of mica, to a more or less deep black, or its augmentation to white, may be used; and the application of the mica plates deserves the preference in all those cases in which the object acts but feebly upon polarized light. In the case of objects, however, which possess this property to a considerable degree, the selenite plates are preferable, because the contrast of the brilliant complementary colours, apparent under these circumstances, is very striking. To produce these colours clearly, a series of selenite plates of increasing thicknesses should also be kept, because,

with objects which strongly polarize light, thicker plates are requisite for this purpose. I therefore use plates which render the field of the microscope of a red colour of the first to the fourth order. In the examination of the elementary organs of plants, the red of the 1st and 2nd order was sufficient, and I seldom found it requisite to use the red of the 3rd and 4th order.

These plates are best inserted between the polarizer and the condenser. Hence these pieces of apparatus of the polarizing microscope must be separate and sufficiently apart to allow of the interposition of the plates, which must be capable of rotation horizontally.

It is scarcely necessary to remark that it is best to cement the plates of mica and selenite between two thin glass plates, and to fix them with paste or some such substance in a circular form.

In conclusion, a word upon the preparation of organic bodies for examination under the polarizing microscope.—As is well known, many organic bodies can only be examined microscopically under water; these are prepared for the polarizing microscope in exactly the same manner as for the ordinary microscope. In those objects, however, which may be dried without structural change, as sections of vegetable cellular tissue, starch-granules, &c., it is far better to place them in some more highly refractive liquid than water, as oil of turpentine, or Canada-balsam; the more nearly the refractive power of the organic body and of the preservative liquid agree, the more transparent does the object become, and the more difficult to be distinguished under the ordinary microscope, whilst it yields a so much more beautifully distinct image in the polarizing microscope. Very few structures form an exception to this rule—such as the silicious carapace of the Diatomaceæ after the application of a red heat, which in fact strictly speaking cannot then be considered as organic bodies; these are best examined in the dry state.

BIBLIOGRAPHICAL NOTICE.

Ceylon: an Account of the Island, Physical, Historical, and Topographical; with Notices of its Natural History, Antiquities, and Productions. By Sir James Emerson Tennent, K.G., LL.D., &c. 2 vols. Longman & Co.

The natural history of the island of Ceylon is a subject so extensive and so important, whether regarded in a scientific or in a commercial point of view, that we must hail with pleasure every new contribution to our knowledge of its animal and vegetable productions; while such is its mineral wealth and the importance of its gems, that we are no longer surprised at the early traditions of their splendour and profusion having given rise to fabulous stories of their abundance and

value. Regarding the fauna of Ceylon, little has been published in any collective form, with the exception of a volume by Dr. Kelaart, entitled 'Prodromus Faunæ Zeilanicæ,' several valuable papers by Mr. Edgar L. Layard, Mr. J. Nietner, and Dr. Kelaart in this Journal, and also some very imperfect lists appended to Pridham's compiled account of the island. Knox, in the charming narrative of his captivity, published in the reign of Charles II., has devoted a chapter to the animals of Ceylon; and Dr. Davy has described the principal reptiles; but, with these exceptions, the subject is almost untouched in works relating to the colony. Yet a more than ordinary interest attaches to the inquiry, since Ceylon, instead of presenting, as is generally assumed, an identity between its fauna and that of Southern India, exhibits a remarkable diversity of type taken in connexion with the limited area over which they are distributed. The island, in fact, may be regarded as the centre of a geographical circle possessing within itself forms whose allied species radiate far into the temperate regions of the north, as well as into Africa, Australia, and the isles of the Indian Archipelago. "In the chapters that I have devoted to its elucidation," says Sir James, "I have endeavoured to interest others in the subject by describing my own impressions and observations with fidelity and with as much accuracy as may be expected from a person possessing, as I do, no greater knowledge of zoology and the other physical sciences than is ordinarily possessed by any educated gentleman. It was my good fortune, however, in my journeys to have the companionship of friends familiar with many branches of natural science—the late Dr. Gardner, Mr. Edgar L. Layard (an accomplished zoologist), and others; and I was thus enabled to collect on the spot many interesting facts relative to the structure and habits of the numerous tribes of animals. These, chastened by the corrections of my fellow-travellers, and established by the examination of collections made in the colony and by subsequent comparison with specimens contained in museums at home, I have ventured to submit as faithful outlines of the fauna of Ceylon."

Such is Sir James Tennent's modest introduction to the work before us; and most efficiently and delightfully has he accomplished his task: careful research and profound scholarship give value to every page; and the accuracy of his descriptions is surpassed only by the elegance of his language and the felicity of his illustrations. We will, however, as we lightly skim through the book as far as it belongs to our own subject, briefly indicate the scenes which he describes.

"Ceylon, from whatever direction it may be approached, unfolds a scene of loveliness and grandeur unsurpassed, if it be rivalled, by any land in the universe. The traveller from Bengal, leaving behind the melancholy delta of the Ganges and the torrid coast of Coromandel, or the adventurer from Europe, recently inured to the sands of Egypt and the scorched headlands of Arabia, is alike entranced by the vision of beauty which expands before him as the island rises from the sea,—its lofty mountains covered by luxuriant

forests, and its shores, till they meet the ripple of the waves, bright with the foliage of perpetual spring. The Brahmins designated it by the epithet of *Lanka*, 'the resplendent,' and in their dreamy rhapsodies extolled it as the region of mystery and sublimity; the Buddhist poets gracefully apostrophized it as 'a pearl upon the brow of India;' the Chinese knew it as the 'island of jewels;' the Greeks as the 'land of the hyacinth and ruby;' the Mahometans, in the intensity of their delight, assigned it to the exiled parents of mankind as a new Elysium, to console them for the loss of Paradise; and the early navigators of Europe, as they returned dazzled with its gems and laden with its costly spices, propagated the fable that far to seaward the very breeze that blew from it was redolent of perfume. In later and less imaginative times Ceylon has still maintained the renown of its attractions, and exhibits in all its varied charms 'the highest conceivable development of Indian nature.'"

The general features of the country are given with an accuracy the very truthfulness of which imparts beauty to the description, and makes us wish, at least for once, in person to witness a scene so lovely, to have one glimpse of a region so paradisiacal.

The climate of Ceylon, from its physical configuration and insular detachment, contrasts favourably with that of the great Indian peninsula. Owing to the moderate dimensions of the island, the elevation of its mountains, the very short space during which the sun is passing over it in his regression from or approach to the solstices, and its surrounding seas being nearly uniform in temperature, it is exempt from the extremes of heating and cooling to which the neighbouring continent of India is exposed. The range of the thermometer exhibits no violent changes, and never indicates a temperature insupportably high. The mean, on an annual average, scarcely exceeds 80° at Colombo, though in exceptional years it has risen to 86°. The line is faint that divides the seasons. No period of the year is divested of its seed-time and harvest in some parts of the island; and the ripe fruit hangs on the same branches that are garlanded with opening buds. Moreover, as every plant has its own period for the production of its flowers and fruit, each month is characterized by its own peculiar flora.

April is by far the most oppressive portion of the year. A mirage fills the hollows with mimic water; the heat in close apartments becomes extreme, and every living creature flies to the shade from the suffocating glare of mid-day. At the end of the month the mean temperature attains its greatest height, being about 88° in the day, and 10° lower at night.

May is signalized by the great event, the change of the monsoon, and all the grand phænomena that accompany its approach.

"Long before the wished-for period arrives, the verdure produced by the previous rains becomes almost obliterated by the burning droughts of March and April. The deciduous trees shed their foliage, the plants cease to put forth fresh leaves, and all vegetable life languishes under the unwholesome heat. The grass withers on

the baked and cloven earth, and red dust settles on the branches of the thirsty brushwood. The insects, deprived of their accustomed food, disappear under ground or hide beneath the decaying bark; the water-beetles bury themselves in the hardened mud of the pools; and the *Helices* retire into the crevices of the stones or the hollows amongst the roots of the trees, closing the apertures of their shells with the hybernating epiphragm. Butterflies are no longer seen hovering over the flowers, the birds appear fewer and less joyous, and the wild animals and crocodiles, driven by the drought from their accustomed retreats, wander through the jungle, and even venture to approach the village wells in search of water. Man equally languishes under the general exhaustion; ordinary exertion becomes distasteful; and the native Singhalese, although inured to the climate, move with lassitude and reluctance.

"Meanwhile the air becomes loaded to saturation with aqueous vapour drawn up by the augmented force of evaporation acting vigorously over land and sea: the sky, instead of its brilliant blue, assumes the sullen tint of lead, and not a breath disturbs the motionless rest of the clouds that hang on the lower range of hills. At length, generally about the middle of the month, but frequently earlier, the sultry suspense is broken by the wished-for change.... .. As the monsoon draws near, the days become more overcast and hot; banks of clouds rise over the ocean to the west; and, in the peculiar twilight, the eye is attracted by the unusual whiteness of the sea-birds that sweep along the strand to seize the objects flung ashore by the rising surf. At last the sudden lightnings flash among the hills, and shoot through the clouds that overhang the sea—and, with a crash of thunder, the monsoon bursts over the thirsty land, not in showers or partial torrents, but in a wide deluge, that in the course of a few hours overtops the river banks and spreads in inundations over every level plain."

Snow is unknown in Ceylon; *hail* occasionally falls in the Kandyan hills; and in 1852 the hail which thus fell was of such size that half-a-dozen lumps would fill a tumbler. "In shape they were oval and compressed, but the mass appeared to have formed a hexagonal pyramid, the base of which was two inches in diameter and about half an inch thick, gradually thinning towards the edge. They were tolerably solid internally, each containing about the size of a pea of clear ice in the centre, but the sides and angles were spongy and flocculent, as if the particles had been driven together by the force of the wind, and had coalesced at the instant of contact."

"A curious phænomenon, to which the name of 'anthelia' has been given, is to be seen in singular beauty at early morning in Ceylon. When the light is intense, and the shadows proportionally dark—when the sun is near the horizon, and the shadow of a person walking is thrown upon the dewy grass—each particle furnishes a double reflexion from its concave and convex surfaces, and to the spectator his own figure, but more particularly his head, appears surrounded by a halo as vivid as if radiated from diamonds." Scoresby describes the occurrence of a similar phænomenon in the arctic seas.

The variation of the tides is so slight that navigation is almost unaffected by it, the ordinary rise and fall being only 18 or 24 inches, with an increase of about a third at spring tides. On both sides of the island, during the south-west monsoon, a broad expanse of the sea assumes a red tinge "considerably brighter than brick-dust;" and this is confined to a space so distinct, that a line seems to separate it from the green water which flows on either side. On obtaining a portion of the water so coloured, and examining it under the microscope, it proved to be filled with *infusoria*.

Nearly four parts of the island are undulating plains, slightly diversified by offsets from the mountain-system which entirely covers the remaining fifth. Every district, from the depths of the valleys to the summits of the highest mountains, is clothed with perennial foliage; and even the sand-drifts, to the ripple on the sea-line, are carpeted with verdure, and sheltered from the sunbeams by the cool shadows of the palm-groves.

"Although the luxuriant vegetation of Ceylon has at all times been the theme of enthusiastic admiration, its flora does not probably exceed 3000 Phænogamic plants. The littoral vegetation of the sea-border exhibits little variation from that common throughout the Eastern Archipelago; but it wants the *Phœnix paludosa*, a dwarf date-palm which literally covers the islands of the Sunderbunds at the delta of the Ganges. Retiring from the strand, there are groups of *Sonneratia*, *Avicennia*, *Heritiera*, and *Pandanus* or Screw-pine.

"A little further inland the sandy plains are covered with thorny jungle; and wherever man has encroached on the solitude, groves of cocoa-nut palms mark the vicinity of his habitations. Remote from the sea, the level country of the north has a flora almost identical with that of Coromandel; but the arid nature of the Ceylon soil, and its drier atmosphere, is attested by the greater proportion of *Euphorbias* and fleshy shrubs, as well as by the wiry and stunted nature of the trees, their smaller leaves, and thorny stems and branches.

"Conspicuous amongst them are acacias of many kinds: *Cassia fistula*, the wood-apple (*Feronia elephantum*), and the mustard-tree of Scripture (*Salvadora Persica*), which extends from Ceylon to the Holy Land. The margosa (*Azadirachta Indica*), the satin-wood, the Ceylon oak, and the tamarind and ebony, are examples of the larger trees; and in the extreme south and west the Palmyra palm takes the place of the cocoa-nut, and not only lines the shore, but fills the landscape on every side with its shady and prolific groves.

"Proceeding southward on the western coast, the acacias disappear, and the greater profusion of vegetation, the taller growth of the timber, and the darker tinge of the foliage, all attest the influence of the increased moisture both from the rivers and the rains. The brilliant *Ixoras*, *Erythrinas*, *Buteas*, *Jonesias*, *Hibiscus*, and a variety of flowering shrubs of similar beauty, enliven the forests with their splendour; and the seeds of the cinnamon, carried by the birds from the cultivated gardens near the coasts, have germinated in the sandy soil, and diversify the woods with the fresh verdure of its polished leaves and delicately tinted shoots.

"Pepper-worts festoon the forest. Along with these the trunks of the larger trees are profusely covered with other delicate creepers, chiefly *Convolvuli* and *Ipomæas*; and the pitcher-plant (*Nepenthes distillatoria*) lures the passer-by to halt and conjecture the probable uses of the curious mechanism by means of which it distils a quantity of limpid fluid into the vegetable vases at the extremity of its leaves. The Orchideæ suspend their pendulous flowers from the angles of branches, whilst the bare roots and the lower part of the stem are occasionally covered with fungi of the most gaudy colours, bright red, yellow, and purple.

"Of the east side of the island the botany has never yet been examined by any scientific resident; but the productions of the hill country have been largely explored, and present features altogether distinct from those of the plains. For the first two or three thousand feet the dissimilarity is less perceptible to an unscientific eye; but as we descend, the difference becomes apparent, in the larger size of the leaves, and the nearly uniform colour of the foliage, except where the scarlet shoots of the iron-wood tree (*Mesua ferrea*) seem like flowers in their blood-red hue. Here the broad leaves of the wild plantains (*Musa textilis*) penetrate the soil among the broken rocks; and in moist spots the graceful bamboo flourishes in groups, whose feathery foliage waves like the plumes of the ostrich.

"Here peaches, cherries, and other European fruit trees, grow freely; but as they become evergreens in this summer climate, as if exhausted by perennial excitement, and deprived of their winter repose, they refuse to ripen their fruit.

"The tea-plant has been raised with entire success in the hills on the estate of the Messrs. Worms, at Rothschild, in Pusilawa; but the want of any skilful manipulators to collect and prepare the leaves renders it hopeless to attempt any experiment on a large scale, until assistance can be secured from China to conduct the preparation.

"Still ascending, at an elevation of 6500 feet, as we approach the mountain plateau of Neura-ellia, the dimensions of the trees again diminish; the stems and branches are covered with Orchideæ and mosses, and around them spring up herbaceous plants and balsams, with here and there broad expanses covered with *Acanthaceæ*, whose seeds are the favourite food of the jungle-fowl, which are always in perfection during the ripening of the Nilloo. It is in these regions that the tree-ferns (*Alsophila gigantea*) rise from the damp hollows and carry their gracefully plumed heads sometimes to the height of 20 feet. At length in the loftiest range of the hills the Rhododendrons are discovered—no longer delicate bushes as in Europe, but timber-trees 50 to 70 feet in height, and of corresponding dimensions,—every branch covered with a blaze of crimson flowers. In these forests are also to be met with some species of *Michelia*, the Indian representatives of the Magnolias of South America, several arboreous *Myrtaceæ* and *Ternstrœmiaceæ*, the most common of which is the camelia-like *Gordonia Ceylonica*. These and *Vaccinia Gaultheria*, *Goughia*, and *Gomphandra* establish the affinity between the vegetation of this region and that of the Malabar ranges, the Khasia and Lower Himalaya."

The list of Mammalia belonging to the Singhalese fauna is by no means numerous. Troops of monkeys inhabit the forests, careering in ceaseless chase through the loftiest trees; but these are all ranged under five species, four of which belong to one group, the Wanderoos; the other is the little, graceful, grimacing Rilawa (*Macacus pileatus*), the universal pet and favourite of both natives and Europeans. The only other quadrumanous animal is the little Loris, which, from its sluggish habits, has acquired the name of the "Ceylon Sloth." The multitude of *bats* is one of the features of the evening landscape: they abound in every cave and subterranean passage, in the tunnels on the highways, in the galleries of the fortifications, in the roofs of the bungalows, and the ruins of every temple and building. At sunset they issue from their diurnal retreats, and roam through the twilight in search of crepuscular insects; and as night approaches, and the lights in the room attract the night-flying Lepidoptera, the bats sweep round the dinner-table and carry off their tiny prey within the glitter of the lamps. The colours of some are brilliant as the plumage of a bird.

Of the Carnivora the one most dreaded by the natives is the *bear*, which makes the depths of the forests its habitual retreat. Leopards, or rather panthers (*Felix pardus*), are the only formidable members of the tiger race in Ceylon, but they are neither very numerous nor very dangerous, as they seldom attack man. The jackals (*Canis aureus*) in the low countries hunt in packs; and the small number of hares in the districts they infest is ascribed to their depredations. They are occasionally subject to hydrophobia; and instances are frequent of cattle being bitten by them, and dying in consequence. Of the Mungoos or Ichneumons five species have been described, some of which feed upon the most poisonous serpents. Numbers of smaller quadrupeds enliven the forests and lowland plains with their graceful movements. Squirrels are in great variety; and of the "flying squirrel" (*Sciuropterus*) there are two species, of which one (*S. Layardii*) is peculiar to the island. Rats are abundant, and of several kinds, among which the tree-rat and the coffee-rat may be noticed; these latter inhabit the forests, and, like the Lemmings of Norway and Lapland, migrate in vast numbers. The Malabar coolies are so fond of their flesh that they evince a preference for those districts in which the coffee plantations are subject to these incursions. They fry the rats in oil, or convert them into curry. The "pig-rat," or Bandicoot (*Mus bandicota*), likewise furnishes a dish relished by the planters.

Of the *Edentata* the only example in Ceylon is the scaly ant-eater (*Manis pentadactyla*), usually known by its Malay name of Pengolin, a word indicative of its faculty of rolling itself up into a compact ball; these live principally upon the termite ants. When at liberty, they burrow in the ground to a depth of seven or eight feet, where they reside in pairs.

Four species of deer, some varieties of the humped ox which have been introduced from the opposite continent of India, and the buffalo, represent the Ruminantia. The elephant and the wild boar are the only Pachyderms in the island. Among the rarer mammals

the Dugong (*Halicore Dugong*, F. Cuv.) may be enumerated as occurring on various points of the coast.

Of the Birds of the island upwards of three hundred and twenty species have been indicated by the persevering labours of Dr. Templeton, Dr. Kelaart, and Mr. Layard; but many yet remain to be identified. In fact, to the eye of a stranger their prodigious numbers, and especially the myriads of water-fowl, which, notwithstanding the presence of the crocodiles, people the lakes and marshes in the eastern provinces, form one of the marvels of Ceylon.

Among the Reptiles, one of the earliest, if not the first remarkable animal to startle a stranger, is the Iguana, a huge lizard of from four to five feet in length, which may be seen at noon-day searching for ants and insects in the middle of the highway and along the fences. This, however, is but the stranger's introduction to innumerable varieties of lizards, all most attractive in their sudden movements, and some unsurpassed in the brilliancy of their colouring, which bask on banks, dart over rocks, and peer curiously out from the chinks of every ruined wall. The true Chameleon is found, but not in great numbers. The *Ceratophora* are likewise remarkable; but the most familiar and attractive of the class are the Geckoes, which frequent the sitting-rooms, and, being furnished with pads to each toe, are enabled to ascend perpendicular walls and adhere to glass and ceilings. Crocodiles are abundant, and afford a fertile theme, as do tortoises and turtles. Of Snakes the Singhalese profess to distinguish a great many kinds; but so cautiously do serpents make their appearance that the surprise of long residents is invariably expressed at the rarity with which they are to be seen. Davy, whose attention was carefully directed to the poisonous serpents of Ceylon, came to the conclusion that but four out of twenty species examined by him were venomous, and of these only two, the *Tic-polonga* (*Daboia elegans*) and the Cobra de Capello (*Naja tripudians*), were capable of inflicting a wound likely to be fatal to man. The third is the *Carawilla* (*Trigonocephalus hypnale*), a brown snake of about twelve inches in length; and for the fourth the Singhalese have no name in their language,—a proof that it is neither deadly nor abundant. In the numerous marshes there are many varieties of Frogs, which, both by their colours and extraordinary size, are calculated to excite the surprise of strangers; the graceful Tree-frogs (*Hyla*) may likewise be found in great numbers crouching under broad leaves to protect them from the sun. They possess in a high degree the power of changing their colour; and one which had seated itself on the gilt pillar of a dinner-lamp was scarcely to be distinguished from the *or molu* to which it clung.

An interesting chapter is devoted to the fishes of Ceylon, numbering upwards of six hundred species and varieties. The notices concerning the Mollusca, Insecta, Crustacea, Arachnida, Myriapoda, and Radiata are likewise important and copious. Lists are given, which want of space precludes the possibility of more than adverting to. We trust, however, that we have said enough to indicate, at least, the copious stores of information contained in this really

valuable addition to our literature. We have of course confined our remarks to that department of the work which is more immediately devoted to the natural history of the country; and yet this is by no means the scope of the book before us. The Singhalese chronicles have been ransacked, Buddhism and Buddhist monuments explored with careful minuteness, population and caste, sciences and the social arts, agriculture and commerce, manufactures and literature, are in turn treated of, and the mediæval history of Ceylon traced with the hand of a master and an erudition rarely brought to bear upon such a subject.

The second volume is devoted to the modern history and resources of the country, including a chapter upon Elephants, replete with anecdote, and illustrated, as indeed is the rest of the work, with woodcuts of no ordinary excellence.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

Jan. 25, 1859.—E. W. H. Holdsworth, Esq., F.L.S., in the Chair.

Notes on the Habits of the Mycteria australis or New Holland Jabiru (Gigantic Crane of the Colonists). By George Bennett.

A short time since, I purchased this rare bird, which was brought alive to Sydney from Port Macquarie, and so little being known respecting its habits, I considered the following notes might be interesting to the Society. It appears to be a young male, and walks about the yard of the house quite domesticated, making no attempt to fly, nor showing any inclination to leave its domicile. These birds have a wide range over the colony, more particularly about the northern coasts of Australia, and are seen occasionally within the heads and about the sand-banks of the Clarence and Macleay Rivers; they are very difficult of approach, and consequently but few have been obtained, this being the first specimen ever brought alive to Sydney. Among the principal residents in the interior, some inform me that they have only seen four, others only one, during a residence of from twenty-five to thirty years in different parts of the colony. In Leichhardt's Expedition (according to the account of Mr. Murphy, now residing in Sydney) only two were seen; and these could not be approached sufficiently near to be shot. In 1839 a specimen was shot on Hunter's River, and another on the north shore near Sydney about three years since, both of which were presented to the Australian Museum. The person who shot the last bird had the greatest difficulty in procuring it, from its being so very shy and watchful: he was obliged to follow it for several days in its haunts about the salt-water creeks, until he could get sufficiently near to shoot it, which, being a good marksman, he achieved as soon as he could approach within range. Both these specimens were full-

grown males, and in fine and brilliant adult plumage. These birds being so rarely seen, and difficult to procure when seen, are valuable as specimens when dead, and much more so when alive. Many of the residents of the northern districts had seen the bird, but rarely, and at a distance, and were aware how difficult it was to procure it; but none had ever seen it in captivity before, and it was therefore regarded with great interest. The number of skins of this bird I have seen during my residence of twenty-two years in the colony only amounts to four. The bird is very graceful: its attitudes, and bearing, whether in a state of repose, stalking rapidly, or walking gently over a lawn or yard with its measured, noiseless steps, have a combination of grace and elegance, and it displays an independence of manner that might be expected in a bird so wild and roaming in its habits. It is gentle and good-tempered, soon gets reconciled to captivity, and seems to take pleasure in being noticed and admired, remaining very quiet to be looked at—keeping a bright eye upon the spectator, however, during the time. Although, when first seen, it has an uncouth appearance, from the large size of the mandibles in proportion to the body, yet on a closer acquaintance its manner wins upon you, and a feeling of attachment arises towards it from its placid, tame, domesticated manner, elegance of form, graceful carriage, and beautiful metallic brilliancy of plumage, more especially over the head and neck.

This bird had been in captivity four months previous to its arrival in Sydney, having been captured by the blacks. It permits any one to approach it, only timidly moving away when an attempt is made to touch it. It sometimes stands quite erect, or on one leg, with the other thrown out; or rests upon the tarsi, like the Emeu and Mooruk, and again upon one leg, with the bill inclined upon the breast. It was very hungry on its arrival at my house, and with the greatest facility devoured 1½ lb. of beef cut into small pieces, placed in a tub of water, or caught the meat in the mandibles when thrown to it. It also feeds on fish and reptiles. When the food is hard or gristly, it is rejected from the mandibles after trying to masticate it, and bruised with the point of the beak until it becomes sufficiently soft to be swallowed. It feeds generally in the mornings and evenings; and although the mandibles look so large, it picks up the smallest object with great readiness, and clatters the mandibles with a loud noise when catching flies. It preens its feathers, and removes any dirt or insects from them very neatly with the bill, accompanying the action with a degree of ease and grace pleasing to observe. When a tub of water was placed near it, it placed one leg in it; and after drinking, filled its bill with water and threw it out again, as if washing out the mandibles. The eye is very large and remarkably brilliant, and yet imparts to the bird a great docility of expression, making it appear—what it is—an amiable bird, familiar with all around it, liking to court admiration, yet on the watch for any act of aggression. It appears pleased to see any stranger, and evinces but little fear. The horses coming into the yard even close to it, or any noise, do not seem to annoy it; it only moves gently out of the way.

When suddenly startled, it will flap its long and powerful wings as if preparing for flight; and it may be regarded as a bird of flight, the whole bulk of the body being so light in comparison with its powerful organs of flight. This bird is partial to salt-water creeks and lagoons. It is usually seen in such localities on the Hunter, Macleay, and Clarence Rivers, which consist, near the entrance and for some miles distant, of salt water with numerous sand-banks, where these birds may be occasionally observed busily engaged in fishing. The beak of this bird is large, broad, conical, and pointed; the lower mandible is slightly curved upwards; the colour is black. The head is large, and neck thick; both the head and neck are of a rich deep glossy green, changing when it reaches the occiput into beautiful iridescent colours of violet and purple, which, when viewed under a brilliant sunshine or in a changing light, display the iridescent tints in a most brilliant manner, shining with a metallic effulgence equal to that seen in the Peacock. The greater wing-coverts, scapularies, lower part of the back and tail, dark brown mixed with rich bluish green, which changes in the adult to a rich glossy green tinged with a golden lustre. The smaller wing-coverts, lower part of the neck and back, and upper part of the breast white speckled with ashy brown, which becomes white in the adult; lower part of the breast, thighs, and inner part of the wings white. Eyes brilliant, and dark hazel in colour. The legs are blackish with a dark tinge of red, becoming in the adult of a bright red colour, which, as I have been informed, when the bird flies with the legs stretched out, looks like a long red tail. The legs are usually dirty with excremental matter, imparting to them a white appearance, so that the natural colour is seldom seen, except when they just emerge from the water. It is a large feeder, and these birds must consume, in their native haunts, a great quantity of fishes and reptiles. It measures 3 feet 10 inches to the top of the head, and is not yet full-grown; they are said to attain 4 to 5 feet in height. It is shy in disposition and difficult of approach in its wild state; this can readily be supposed when it is observed in captivity; for although very docile and readily tamed, still the keen, watchful eye appears always upon you, with a brilliant and piercing look, which causes a feeling of the impossibility of escaping its penetrating glance. Its feeding-grounds and places of rest being about sand-pits, sand-banks, and exposed morasses near the sea-coasts, it is impossible to approach this wary bird without being seen. The first evening it was at my house, seeking for a roosting place, it walked into the hall, gazed at the gas-lamp which had just been lighted, and then proceeded to walk up-stairs, but not liking the ascent, quietly walked down again and returned into the yard, and afterwards went to roost in the coach-house between the carriages, to which place it now retires regularly every evening soon after dark. It is always observed to face the sun, and moves about the yard, following the course of that luminary; it may always be found in that part of the yard where the sun is shining, and with the face invariably towards it. When hungry, it follows the cook about (who usually feeds it); and if she has neglected its food, looks into

the kitchen as if to remind her of the neglect, and waits quietly, but with a searching eye, during the time the meat is cutting up, until it is fed. It is amusing to observe this bird catch flies: he remains very quiet, as if asleep, and on a fly passing him, it is snapped up in his beak in an instant. The only time I observed any manifestation of anger in him was when the "Mooruks" were introduced into the yard where he was parading about: these rapid, fussy, noisy birds running about his range excited his indignation; for on their coming near him, he slightly elevated the brilliant feathers of the head, the eyes became very brilliant, he ruffled his feathers, and clattered his mandibles as if about to try their sword-like edge upon the intruding "Mooruks;" but his anger subsided with these demonstrations, except an occasional flapping of his powerful wings. One day, however, on one of the "Mooruks" approaching too near him, he seized it with his mandibles by the neck, on which the "Mooruk" ran away and did not appear in any way injured.

MISCELLANEOUS.

On the Electrical Organs of Fishes. By M. Schultze.

The remarkable researches of M. Bilharz upon the *Malapterurus* commenced a new era in the history of the electrical fishes, by the discovery of the so-called electrical nervous plates. The subsequent works of MM. Kölliker, Ecker, Kupffer, and Keferstein tend to show that these plates exist in all the electrical fishes. M. Schultze now furnishes us with more exact details upon these interesting organs in the Torpedo.

In their microscopic appearance, the prisms of the Torpedo exactly resemble those of the Gymnotus; nevertheless the employment of the microscope soon shows some remarkable differences of structure in them. The transverse partitions, which in the Gymnoti are formed by fibrous conjunctive tissue, present a far more delicate texture in the Torpedos, being composed of gelatinous conjunctive tissue or mucous tissue (*Schleimgewebe*). This difference, however, is in relation to the great development which the gelatinous conjunctive tissue in general acquires in the organs of the Plagiostomi. These partitions are traversed by vessels and nerves, like the more resistant and fibrous walls of the prisms. In the spaces enclosed between the gelatinous transverse septa, other transverse partitions, of far greater solidity, are arranged; these are, properly speaking, the transverse septa hitherto indicated by different authors. A gelatinous partition therefore alternates regularly with a more solid one; and in this latter M. Schultze recognizes an electrical plate.

Hitherto the gelatinous partitions (the true septa, according to M. Schultze) were regarded as spaces filled with a liquid, in which the nerves and vessels were freely suspended. Pacini, and after him Remak and Kölliker, perceived that in each of these supposed spaces the nerves form a delicate network applied against the *lower* surface of each of the solid partitions (*electrical plates* of Schultze). This arrangement is confirmed by Schultze, who says that the nerves

always adhere to the ventral surface of the electrical plate, whilst the dorsal surface is completely free. The nervous network of the inferior surface forms a very elegant system of regular meshes, which agrees perfectly with the figure given of it by M. Kölliker, and which appears to be intimately united with the substance of the electrical plate. These meshes are of extreme fineness, and can only be distinguished by means of a high magnifying power. The electrical plate itself (*septum* of authors) is a perfectly transparent homogeneous plate; its thickness is only 0·001 to 0·002 line, and it presents here and there a few scattered nuclei. It is hardly possible to give a positive proof of the continuity of tissue which M. Schultze assumes to exist between this plate and the minute ramifications of the nervous network, for the latter is of extreme tenuity. However, it is impossible to separate the nervous network as a continuous layer from the plate. The author depends principally upon chemical considerations in claiming for these plates the part of electrical plates. In fact, they are not formed of conjunctive tissue, but are of an albuminous nature. Under the action of a solution of sugar and sulphuric acid, they acquire a rose-colour, like the electrical plates of other electrical fishes. Ebullition in water, which dissolves the conjunctive tissue of the longitudinal walls of the prisms and the transverse gelatinous septa, separates the plates from each other. These facts are sufficient to show that Kölliker was wrong in considering these plates as of the nature of conjunctive tissue.

Relying on the preceding investigations of R. Wagner and Pacini, without having examined the Torpedo for himself, Bilharz thought that the homogeneous membranes with scattered nuclei, of these fishes, might be compared with the electrical plates of *Malapterurus*. This assimilation now appears to be well founded. Schultze, like Leydig, certainly shows that not only nuclei but also true cells with a very transparent membrane are found here and there in the homogeneous plates of the Torpedos, while nuclei alone are met with in the electrical plates of *Gymnotus* and *Malapterurus*. But this difference is evidently of no importance. The author thinks, moreover, that these nuclei and cells are of purely embryonal signification, inasmuch as these elements would be destined to secrete the fundamental or essential substance of the plate in which the nervous fibrillæ terminate. In this point of view, the electrical plate would only be a kind of tabular development of the axial cylinder.

The investigations of M. Schultze furnish a new confirmation of the remarkable result previously enunciated by Kupffer and Keferstein, that, in all electrical fishes, that face of the electrical plate to which the nerves adhere is turned to the negative, and the free face to the positive side of the fish.

M. Schultze terminates his memoir with some profound chemical investigations upon the electrical organ of the Torpedos and the pseudo-electric organ of the Rays. Amongst the substances detected we shall indicate, especially, urea in very large quantities, syntonine, and a peculiar albuminous body.—*Abhandl. der naturforsch. Gesellsch. zu Halle*, 1859; *Bibl. de Genève*, 1859, *Bull. Scient.* p. 83.

Researches upon some of the lower Marine Animals. By R. Leuckart and A. Pagenstecher.

Under this title, MM. Leuckart and Pagenstecher have published the results of some investigations made at Heligoland. The following are some of the most interesting of these notes:—

Amphioxus lanceolatus.

The authors, like M. Schultze, have examined immature individuals of this interesting vertebrate animal; but, while the latter observer had only two specimens under his hands, they have been able to collect a considerable number. They were struck by the great want of symmetry which characterizes the young animals,—a want of symmetry of which Johann Müller recognized traces in the adult *Amphioxus*, and which has also been indicated by MM. Schultze and Kölliker. It is manifested principally in the following manner:—the mouth, the anterior branchial aperture, the olfactory organ, and the eye are all situated on the left side; the branchial ridges are differently arranged to the right and left of the median line; and the loop-like organs, of problematical signification, included between them are also different. The dorsal portion of the animal is perfectly symmetrical; and the great development which it acquires in the adult animal gradually renders the want of symmetry in the ventral region less apparent.

The authors have ascertained that the *chorda dorsalis* of the *Amphioxus* is provided with a longitudinal groove on its upper part, so that its transverse section is cordate. In this groove is lodged the inferior convexity of the spinal cord. The anterior extremity of the medulla encloses a small cavity (a kind of ventricle), into which the spinal canal opens. Perhaps, in this arrangement, we may see the indication of a rudimentary brain.

The number of branchiæ varies between eleven and seventeen. The new branchiæ make their appearance behind those already in existence. They are all placed immediately beneath the alimentary canal, without any direct communication with the latter. The ventral wall of the animal is cleft along the median line in such a manner as to allow the branchial apparatus to float freely in the sea. This long fissure, which is called the posterior respiratory aperture by the authors, allows the water which has been employed in respiration to flow off. This respiratory apparatus of the young animal is easily seen to be very different from that of the adult, as described by Johann Müller; it is probable that the respiratory apparatus of the young animal becomes transformed directly into that of the adult by the formation of a cartilaginous branchial skeleton, and the establishment of a direct communication between each branchia and the interior of the intestine. At the same time, the fissure just indicated must be closed in such a way as only to leave a single small aperture—the abdominal pore of Müller. Close to the mouth, on the left side of the animal, there is a fissure imperfectly seen by Schultze, which the authors have ascertained to be the anterior branchial aperture.

The young individuals observed by the authors did not possess the least trace of a vascular system, or of generative organs.

The Pilidia, larvæ of Nemertinæ.

The observations of the authors completely bear out those of Krohn, which show that the *Nemertes* (*Alardus*, Busch), which is generally found in *Pilidium*, is not a parasite upon those animals, but that it is produced by them, by means of a sort of gemmation. Besides the common species (*Pilidium gyrans*), the authors have investigated a new species, which they call *P. auriculatum*. They have arrived at highly interesting results; they show that certain worms of the Order *Nemertinæ* present a mode of development which may be brought into complete parallelism with the remarkable genetic history of most Echinoderms. The development of the *Nemertes* in its *Pilidium* is precisely the same with that of an *Echinus* or an *Ophiura* in its *Pluteus*. But, whilst in the Echinoderms it is only the stomach of the larva that passes into the perfect animal, not only the stomach, but also the œsophagus and the mouth of the *Pilidium* are preserved in the *Nemertes*.

Tomopteris.

The authors demonstrate that Burmeister was wrong in classing *Tomopteris* among the Mollusca. They are true Annelides, as Grube first maintained. It would even appear that their most natural position is beside *Chætopterus*.

Sagitta germanica.

Although the anatomy and a considerable portion of the development of the *Sagittæ* have been sufficiently made known by the works of Wilms, Krohn, Gegenbaur and others, the recent statements of Meissner (1856) upon the evolution of these little animals give a particular interest to the researches of MM. Leuckart and Pagenstecher. In fact, although most observers are now agreed in classing the *Sagittæ* among Vermes, Meissner succeeded in unsettling the faith of some people, by describing in the young *Sagittæ* of the sea of Heligoland a *chorda dorsalis* and a spinal cord,—in a word, organs which appear to give this animal a place amongst the Vertebrata. The investigations of the authors, made upon the same species that was studied by Wilms and Meissner, show that the older authors were not deceived in placing the *Sagittæ* amongst the true Worms; and these two observers cannot at all account for the evidently erroneous statements of Meissner.

Echinobothrium typus.

This Cestoïd worm, which has already been studied by Van Beneden and others, lives as a parasite in various species of Rays. The authors have been able to trace its development, which precisely resembles that of other worms of the same Order. In the least advanced stage observed by the authors, the animal presents the form of a vesicle (embryonal vesicle), of which one of the poles exhibits a

depression or aperture formed by the turning-in of the wall towards the interior; this depression becomes a second vesicle, within the former. It is at the bottom of this second vesicle that the scolex sprouts forth. The latter increases in length until it can no longer find room within the vesicle, when it issues out through the aperture. It then exhibits a division into segments.

The embryonal vesicle contains in its walls a great number of calcareous concretions. The authors found that Claparède was quite right in supposing that the same relations would be found to exist between the calcareous corpuscles and the vascular system of the Cestoid Worms that he observed in the corresponding organs of the Trematoda. These corpuscles are, in fact, lodged in inflated portions of the finest branches of the vessels. The authors appear to think, moreover, that there exist two vascular systems opening into the same principal trunks; one of these being in relation with the calcareous corpuscles, while the other has nothing to do with them. The segments of the *Echinobothrium* separate from each other at a period when the semen is not yet formed, which leads to the supposition that the proglottis-phase is of rather long duration. The cystic form of the worm lives, as indicated by Van Beneden, in the Prawns.

Development of Spio.

The authors describe nearly the whole series of metamorphoses of a larva, belonging undoubtedly to the genus *Spio*. Some isolated stages of these metamorphoses have been observed by Busch and Lovén, and perhaps also by Slabber and Oersted. In its young state the larva has a somewhat elongated body, furnished with two bands of cilia, one placed about the middle, the other towards the posterior extremity. Subsequently the anterior portion is developed, so as to form two ciliated cephalic lobes, between which the mouth is situated; two bundles of setæ make their appearance, and the segments of the body begin to be indicated. Soon afterwards the eyes appear, each segment acquires its bundles of setæ, and the larva gradually approaches the form of the perfect animal. —*Archiv für Anat. und Physiol.* 1858, p. 558; *Bibl. de Genève*, 1859, p. 73.

On a new genus of Goat-sucker, and on a new species of Enicurus, *both from Darjeeling, from the Collection of* Brian H. Hodgson, Esq. By George R. Gray, F.L.S.

Ototrhix, G. R. Gray, gen. nov.

This bird differs from the Indian *Batrachostomi* in the smallness of its bill, and in the general markings of its plumage, which agree in some measure with the species of true *Podargus*.

The feathers over the upper mandible in front of the head and above the ears are much prolonged into fine hair-like bristles; they are composed of a long slender stem, having very slender branches springing from the sides at various distances, and thus agreeing

with those of the Australian genus *Ægotheles*. The bill is strong, with the nostrils situated like those of *Batrachostomus*, and of similar form.

These characters induce the proposal of a new division for this remarkably curious species, under the appellation of *Otothrix*.

OTOTHRIX HODGSONI.

Head black, each feather banded and slightly margined with rufous-white; the back and wing-coverts ferruginous, mottled with black, and varied with occasional blotches of white; the quills, secondaries, and tertials brownish-black, marked on the outer and inner margins with blotches of rufous-white; tail ferruginous, speckled with black, obliquely banded on each web with rufous-white, which is irregularly margined and marked with black, and tipped with black, slightly edged with white. Beneath the body white, tinged in some parts with rufous, and each feather irregularly marked at or near the tip with black.

Total length $10\frac{1}{2}''$, wings $5\frac{1}{4}''$.

Young bird.—Pale rufous, having each feather barred with black, a band over the eyes crossing the forehead, and some spots on the scapulars pure white. Under surface white, tinged with rufous, and barred with brown.

This remarkable bird is named after Brian H. Hodgson, Esq., as it forms part of the enormous collection of Birds made by that gentleman in Northern India, especially Nepaul, Behar, &c., many of which were new to science. Some of these have been described by Mr. Hodgson in the 'Asiatic Researches,' 'Journal of the Asiatic Society,' &c., while others have been recently described in Dr. Horsfield's 'Catalogue of the Birds in the Museum of the East India Company.' Not content with forming such large collections of skins, he, at the same time, had them represented in a series of instructive drawings, introducing the sterna and other anatomical illustrations of peculiarities in their organic structure; while many of them also show the formation of the nests, &c., most of which particulars were hitherto unknown. These collections together form a series of materials for ornithologists that has been but rarely equalled by the collection of any other naturalist of late years. We are therefore well warranted in designating this singular bird in honour of Mr. Hodgson, as showing our appreciation of his labours in the cause of ornithological science.

ENICURUS NIGRIFRONS, Hodgs.

Black; upper tail-coverts, a band across the middle of each wing, the base of the middle feathers and the two outer feathers of tail, and under surface white; the throat and breast mottled with black and white; bill black; legs pale yellow.

Total length $6''$, wings $2''\ 11'''$, tarsi $1''$.

This species is easily distinguished from all the rest of the species of *Enicurus* by the black forehead and mottled breast.—*Proc. Zool. Soc.* Feb. 8, 1859.

Notice of a Black-headed Gull found recently in Devonshire. By F. W. L. Ross, Esq.

Among the many objects of natural history which have been discovered during the past months may be noticed the following remarkable bird.

This bird, to which may be applied the term of the giant of the Black-headed Gulls, was shot by a boatman, Mr. William Pine, while employed by W. Taylor, Esq., Bridgewater, who was engaged in fishing for Bass in the river off Exmouth, about the end of May or the beginning of June last; it was in company with a flock of ordinary Gulls. Its remarkable size and appearance attracted the attention of the boatman, who, having his gun with him, singled it out, and fortunately obtained the bird, which has since been kindly presented by the above-mentioned gentleman to the writer.

The usual locality of this bird is the shores of the Caspian Sea, but it is also recorded as having been found on the shores of the Red Sea, the Ganges, and the Ionian Islands, as well as accidentally on the margins of the Danube, in Hungary. One is led to suppose that it is by no means a common bird, as examples are rarely seen in collections. It is the

Larus ichthyaëtus, *Pall. Itin.* ii., *Apend.* n. 27; *Id. Zoogr.* ii. p. 322, t. 77; *Rüpp. Atlas*, t. 17.
Great Gull, *Lath. Gen. Syn.* iii. pt. ii. p. 370.
Ichthyaëtus Pallasi, *Kaup.*
Xema ichthyaëtus, *G. R. Gr. List of Gall. &c. B. M.* p. 171.

Head entirely, and part of neck, pure black; the rest of neck, beneath the body, upper tail-coverts, tail, ends of scapulars and secondaries pure white; the rest of upper surface of a pale plumbeous grey; quills pure white, with the ends black and the tips white, which latter colour is more prominent on the first quill, while the second has the black also divided irregularly with white near the end; a small white mark above and beneath the eyes.

Bill at its base livid yellow, with a crimson ring-like spot near the tip, which is fuscous yellow; and the feet fuscous red. When first obtained, the circles round the eyes were red.

Length 25 inches; wings 18 inches 6 lines; tarsi 3 inches; bare part of thigh 1 inch 9 lines; bill from gape 3⅜ inches, from forehead 2 inches 6 lines.

Pallas informs us that this bird when flying emits a hoarse, raven-like cry of kóu, kóu. He further says that it lays its eggs on the bare sand, without the least preparation of a nest: they are in shape an oblong oval, marked with frequent brown spots, with some paler ones intermixed. It is known on the borders of the Caspian Sea by the name of '*Rybak*,' or '*Gluchar*,' and by the Tartars as '*Charabalta.*'

Topsham, Nov. 24, 1859.

INDEX TO VOL. IV.

END OF THE FOURTH VOLUME.

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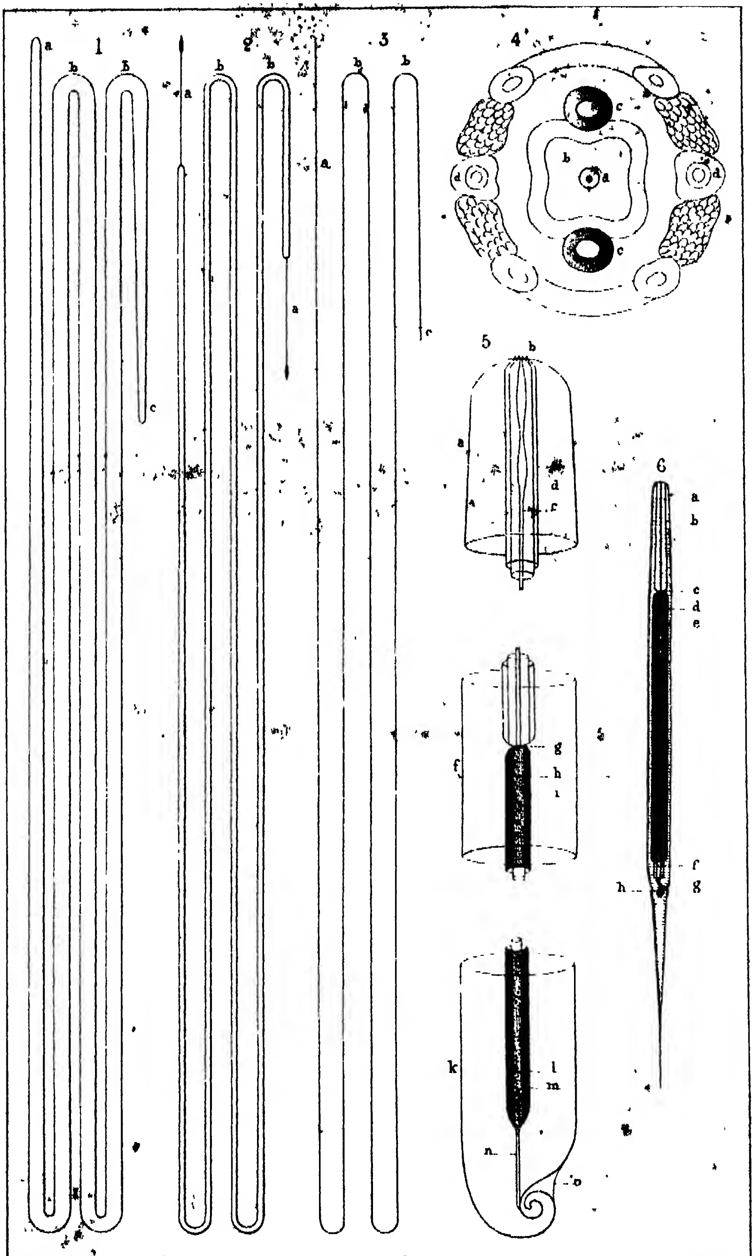

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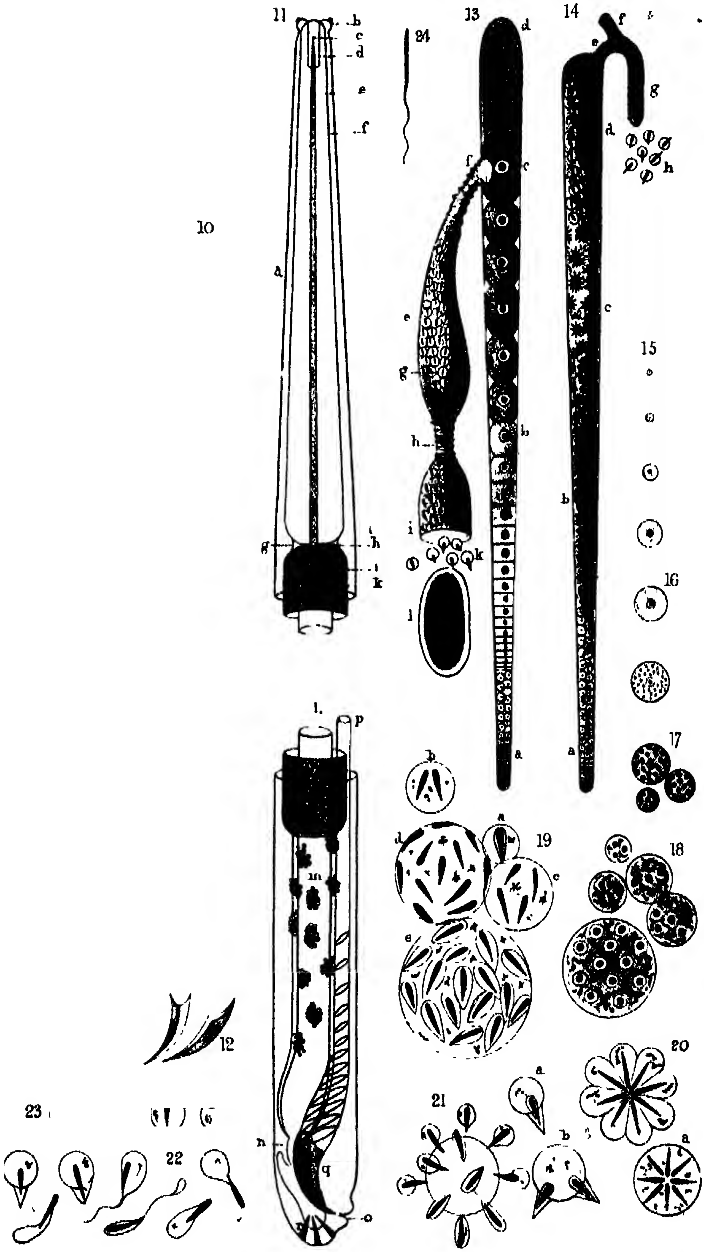

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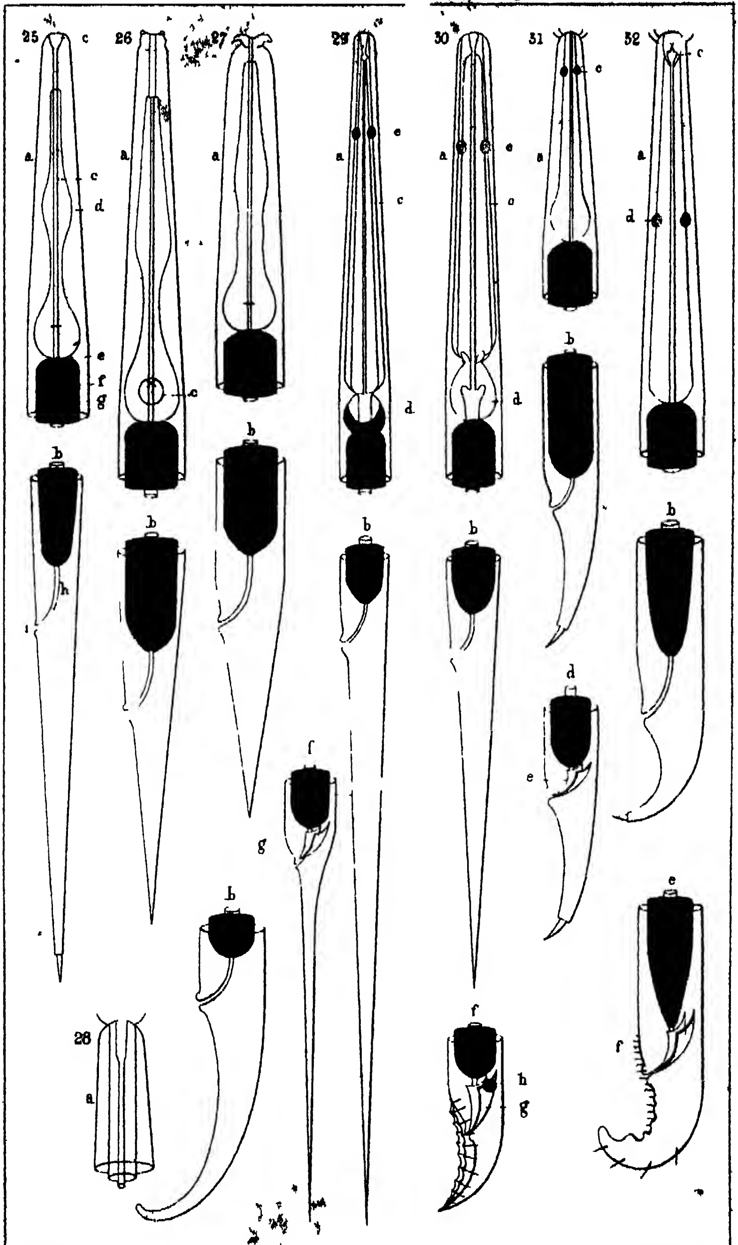

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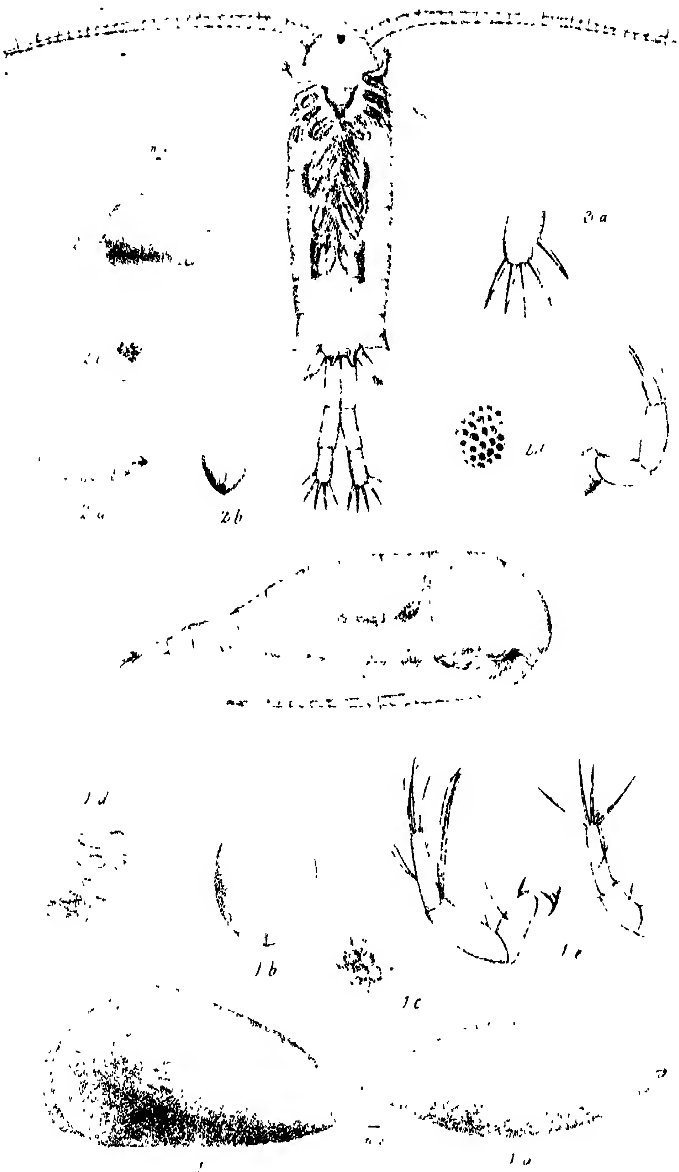

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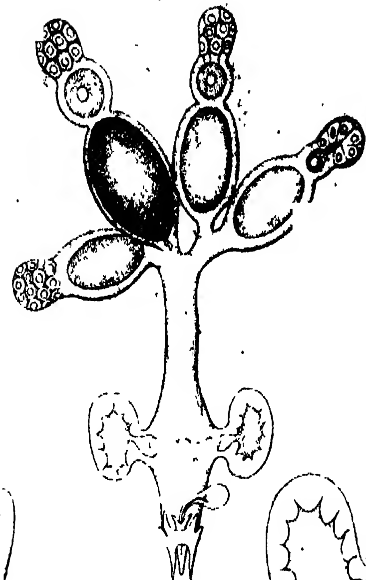

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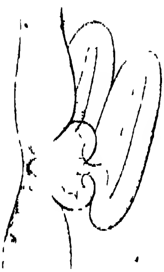

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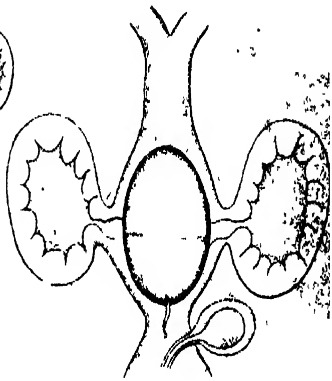

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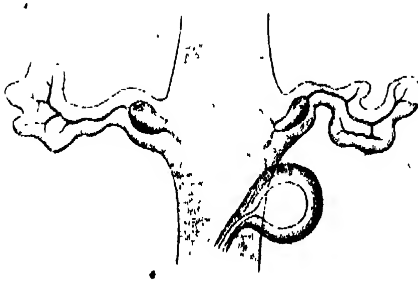

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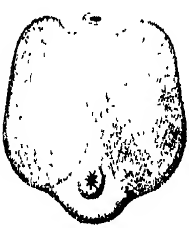

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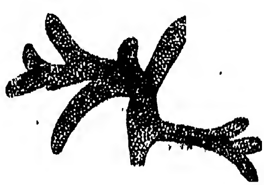

Ann & Mag Nat Hist S. 3 Vol 4 Pl IX

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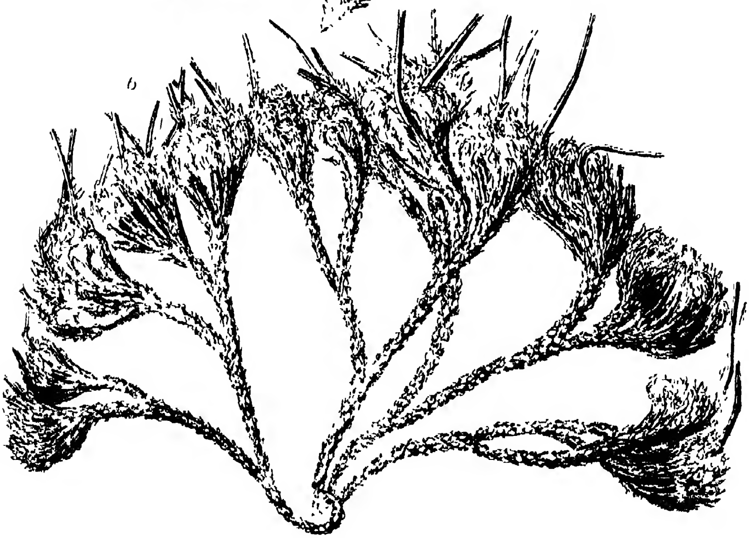

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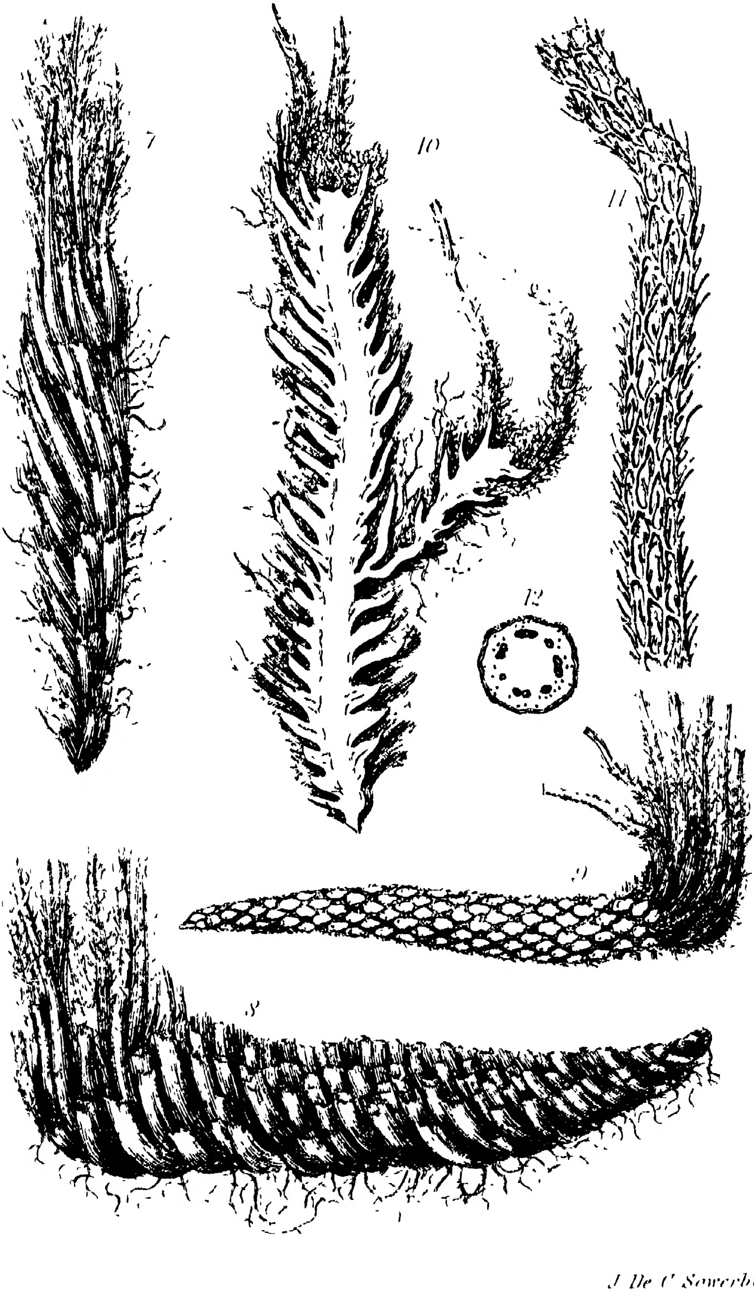

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